XR6/XR3 Transmitter

Installation Manual

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nautel

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The comparisons and other information provided in this document have been prepared in good faith based on publicly available information. The reader is encouraged to consult the respective manufacturer's most recent published data for verification.

Contents

About this manual

This manual provides information about installing an XR6/XR3 transmitter. This manual is intended for use by qualified, trained installers.

Technical support

Nautel offers technical support to customers over the Internet and by telephone. Nautel's customer support team will answer your questions and work with you to identify and resolve problems.

For technical support, call the Customer Support Team at 902-823-3900 or - in U.S.A. and Canada only - call toll free at 1-877-6NAUTEL (662-8835). Or find us on the Internet at http://www.nautel.com.

For parts and tools information, see "Parts and tools" on page 12-1 of the *XR6/XR3 Pre-Installation Manual*.

For accessories or spares, see "Accessories" on page 10-1 of the *XR6/XR3 Pre-Installation Manual*.

For standard warranty information, see "Pre-installation assistance" on page 11-1 of the *XR6/XR3 Pre-Installation Manual*.

For extended warranty information, see "Pre-installation assistance" on page 11-1 of the *XR6/XR3 Pre-Installation Manual*.

XR6/XR3 transmitter manuals

The XR6/XR3 documentation suite includes the following documents:

XR6/XR3 Pre-installation Manual, XR6/XR3-PREINST. The Pre-installation Manual provides instructions and reference information needed when planning and preparing for the installation of an XR6/XR3 transmitter.

Nautel Site Protection Manual. The Site Protection Manual provides detailed information about protecting your site from lightning-related hazards.

XR6/XR3 Installation Manual, XR6/XR3-INST. The Installation Manual provides instructions and reference information needed when installing an XR6/XR3 transmitter.

XR6/XR3 Operating and Maintenance Manual, XR6/XR3-OPS-MAINT. The Operating and Maintenance Manual provides instructions for operating, maintaining and troubleshooting an XR6/XR3 transmitter. It also provides reference information needed when performing diagnostic procedures.

XR6/XR3 Troubleshooting Manual, XR6/XR3-TROUBLE. The Troubleshooting Manual provides detailed technical information about the XR6/XR3 transmitter, including electrical schematics and mechanical drawings.

Nautel website / Online resources

The Nautel website provides useful resources to keep you up to date on your XR6/XR3.

Nautel User Group (NUG)

The website includes a special section that customers can log into in order to access the Nautel customer newsletter, product manuals, frequently asked questions (FAQ), information sheets, and information about field upgrades. Registration is available online and is required.

Documentation: online and printed

The website's NUG section provides online access to all the documentation for your XR6/XR3. Documentation is provided in Acrobat (PDF) format. You can use the documentation online or print the sections that you need.

When using online documents:

- Click on blue text (hyperlinks) to jump to a related section, or to get additional information (e.g., view a term's definition).
- To search a document to find keywords, use Find in Acrobat Reader's Edit menu.
- To quickly find a specific section, click the section in the PDF file's Bookmarks list.

When using printed documents:

- To find keywords, go to the *Index* section at the end of the manual.
- To find a specific term, go to the *List of Terms* section near the end of the manual.

About safety

All Nautel transmitters are designed to meet the requirements of *EN60215, Safety Requirements for Radio Transmitters*.

The philosophy of *EN60215* is that the removal of any cover or panel that can only be opened using a tool is a maintenance activity, and that any person performing a maintenance activity is expected to be trained for that activity. Under *EN60215*, it is assumed that trained personnel will be knowledgeable and will take precautions such as removing all power to the transmitter before accessing its components.

Electrical hazards

To remove power from the transmitter, switch off and lock out the ac power. There are three amber LEDs at the bottom rear of the cabinet that glow to remind anyone who has not turned off the power that the system is live and serious danger is present.

WARNING: It is not enough to remove RF power. The power line is still connected.

Mount the transmitter ac power disconnect switch/breaker close to the transmitter so that it can be reached quickly in an emergency. Clearly label the disconnect switch/breaker (e.g., EMERGENCY SWITCH).

After turning off the power, always perform a measurement to confirm that the power is off before touching anything within the transmitter. If the wrong breaker was opened, the equipment will be live.

WARNING: Do not use an ordinary multimeter to check for voltage, since it may have been left inadvertently on the AMP (A) range, triggering a short and an arc blast that could result in severe burns and even death.

Use only a non-contact voltage probe or a safety voltmeter (available from vendors such as Fluke, Ideal, and Teagam).

Use a proper lockout procedure to ensure that another worker cannot accidentally reapply power while you are performing maintenance on any part of the transmitter or site.

Lightning hazards

Before opening the transmitter and touching internal parts, remove and solidly ground the antenna connection.

WARNING: It is not enough to ground the antenna terminal with the antenna still connected. Even a small impedance in the ground strap will result in lethal voltages during a lightning strike.

RF hazards

A serious RF hazard and very high voltages exist in the vicinity of the antenna and its networks during normal operations.

Toxic hazards

There are devices used in this equipment containing beryllium oxide ceramic, which is non-hazardous during normal device operation and under normal device failure conditions. These devices are specifically identified with "(BeO)" in the *Description* column of the *Troubleshooting Manual's* parts list(s).

Do not cut, crush or grind devices because the resulting dust may be hazardous if inhaled. Unserviceable devices should be disposed of as harmful waste.

Other hazards

Ensure that appropriate fire alarms and fire extinguishers are available. Extinguishers must be suitable for use on electrical fires.

Many other site safety risks exist. It is beyond the scope of this manual to identify all the risks and procedures.

Safety precautions

This section provides very important information about protecting the safety of personnel and equipment:

- Personal safety - see page xi
- Site safety - see page xii
- Equipment safety - see page xiv

Personal safety

Training

The training of any personnel who will have physical access to the site or the transmitter is very important. Personnel must be familiar with the transmitter, so that they can avoid physical danger, and be aware of hazards to themselves and the equipment.

Nautel offers a number of training courses covering the basic fundamentals of RF systems and transmitters, and the operation and maintenance of the transmitter. For more information about available courses and schedules, go to the Nautel website at http://www.nautel.com/Training.aspx, or ask your Nautel sales representative.

Site orientation

When you give personnel access to the transmitter site (e.g., hiring new personnel, or giving access keys to personnel), perform a site orientation to ensure that they are familiar with the site, on-site procedures, and on-site hazards. Cover the following topics:

- Securing the site (locking doors and fences) to prevent unauthorized access
- How and when to call for technical support or emergency assistance
- Areas of the site and pieces of equipment that are *off limits*

Voltage awareness

Ensure that all personnel that are able to access areas with high voltage circuits or high field strengths are aware of the hazards associated with high voltage. Cover the following topics:

- High voltage or high field strength areas where caution is required
- Physical risks of electric shock
- Risks for personnel with pacemakers or other medical implants
- Induced voltages in high field strength areas
- On-site risks during thunderstorms and lightning strikes
- Operation of safety interlocks (if installed)

First aid

Nautel does not offer first aid training, since the hazards associated with high voltage and RF energy are not specific to the transmitter. However, the customer should provide first aid training to all personnel who have access to the transmitter site. First aid training should include CPR, care of burns, artificial respiration, and defibrillation if specific equipment is available on-site.

Site safety

Controlling access

Transmitters and antennas generate and carry dangerous voltages that can be harmful or fatal. It is very important that you control access to the site and its equipment. To secure your transmitter site, use:

- Locking steel or security doors to prevent casual access
- A perimeter fence to keep trespassers away from the antenna system and feedline
- “No Trespassing” signs
- An alarm system

Marking hazards

Place warning signs close to any hazardous areas or systems (e.g., the feedline or the antenna system). Make the signs large enough that they cannot be missed. Provide signage in all languages used in the region. These signs are intended not only for authorized personnel, but also for emergency responders or accidental trespassers.

Qualifying site personnel

Make sure that personnel who have access to the site are qualified to work around electronics and high voltage systems.

Ac power protection

You should take steps to protect equipment from surges (over-voltage spikes) on the ac power lines. Surges may occur during thunderstorms, or because of malfunctions in the electrical distribution grid. Surge suppressors and ac power conditioners can prevent serious damage to your on-site equipment, including the transmitter.

RF protection

Transmitters and their antenna systems create intense radio frequency fields at the transmitter site, particularly near the feedline, antenna and tower. At some sites, these fields may cause biological effects, including the heating of body tissues. Intense fields can also create dangerous high voltages on ungrounded, conductive surfaces and objects. At certain points where high voltage conductors come close to grounded conductors (e.g., at feedline junctions or on the tower), dangerous electrical arcing or flashovers can occur. It is very important that you take the following steps to prevent damage to equipment or personnel due to RF fields:

- Use safety interlocks to de-energize transmitters if personnel open doors or panels accessing high field areas
- Place warning signs in any locations where high fields can occur
- Train personnel about the short-term and long-term hazards of RF radiation
- Physically block access to the area around the antenna system, feedline and tower
- Ground all exposed conductive surfaces or objects in high field areas

The RF connection to the transmitter output can be a serious safety hazard. Connect a 50 Ω test load during installation and commissioning. It is recommended that a switch be used to automatically connect the transmitter to the antenna system without human contact with the transmitting conductors.

Safety interlocks

The transmitter contains an electrical interlock, which is an external circuit that turns off the RF output if any of its switches are opened.

Ac disconnect switch

Safe operation of the transmitter requires an ac disconnect switch. Lock the ac disconnect switch in the disconnected (open) position during the installation process.

Equipment safety

Electrostatic protection

The transmitter's systems are very rugged and resistant to damage. However, it is possible for damage to occur because of high voltage electrostatic discharges during servicing. Train all service personnel to ground themselves to bleed off any static charge before opening the transmitter or touching any exposed components. Provide a grounding wand or known ground (e.g., a grounded metal table) that personnel can use to discharge themselves.

Surge protection

Surge protection is recommended for your entire site. However, even if you do not use a surge protector on the service entrance to the site, you should install a surge protector in the transmitter's ac power feed to prevent over-voltage from entering the transmitter.

Lightning protection

The transmitter is designed to resist lightning strike damage. However, intense or repeated strikes could damage the transmitter. We recommend that you install lightning suppression on the antenna, tower and feedline to reduce the effect of lightning strikes on the transmitter itself (and to protect the rest of your site equipment and your personnel). For detailed information about lightning protection, see the *Nautel Site Preparation Manual*, available from your Nautel sales agent, or online from the Nautel website.

Physical protection

Consider physical hazards to equipment at your site, including the transmitter. Ensure that equipment is protected from weather (e.g., rain or flooding), even during extreme weather events. Place equipment so that it is not in the path of swinging doors or high-traffic areas. Do not allow wheeled items like office chairs or tables with wheels in the transmitter room, as these may damage equipment if accidentally pushed or knocked over. Do not place the transmitter under water pipes, drains, or sprinklers. Keep any equipment that generates heat, like the transmitter, away from flammable materials like ceiling panels, cubicle dividers, and curtains.

Earthquake protection

If the transmitter site is in a region that experiences any noticeable earthquake activity, take steps to prevent the transmitter from shifting or rocking during an earthquake. Even during minor earthquakes, rocking or movement of the transmitter is likely to damage the feedline connection, and could even cause a catastrophic failure of the ac power feed into the transmitter. During larger earthquakes, the weight of the transmitter chassis could be hazardous to nearby equipment or personnel.

Section 1: Preparing for installation

Before installing your XR6/XR3 transmitter, perform the following steps:

1. Ensure that you have performed the pre-installation tasks described in the *XR6/XR3 Pre-installation Manual*.

2. Make sure that you received all the components. (Check your packing list.)

3. Inspect all crates and packages for damage.

4. Report any damage immediately to your Nautel sales representative and the carrier.

5. Move the crates as close as possible to the transmitter's planned location.

6. Unpack the crates in accordance with the instructions provided on the outside of the crates.

   - For each crate, remove the panel labelled **open this side**. The panel is attached using Philips head screws.

   - Remove any visible packing material, including braces, from the crate's interior.

7. Review any assembly notes or instructions contained inside the transmitter crates. (For sites requiring custom configurations, the instructions provided with the transmitter replace the instructions provided here.)

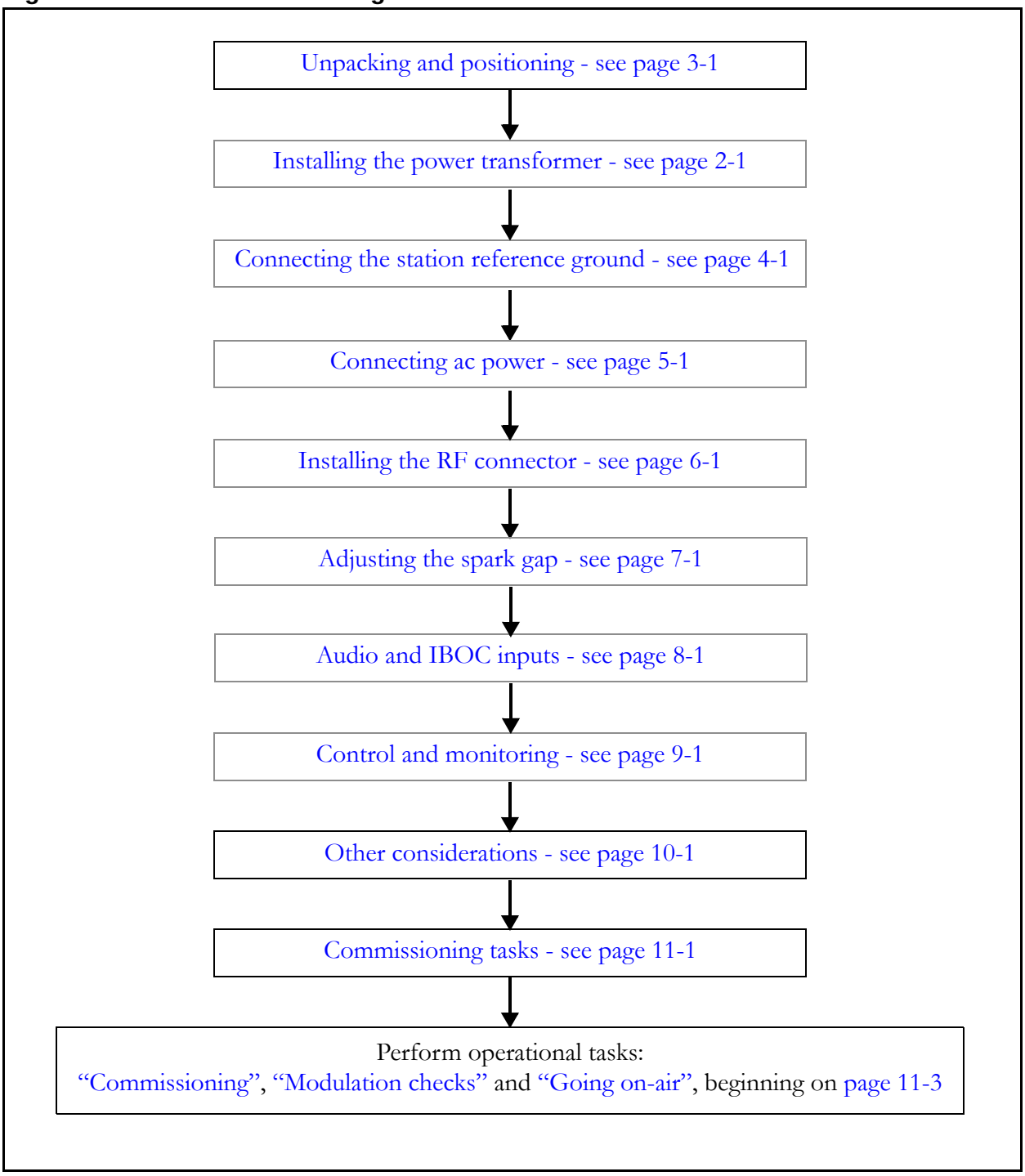
8. Assemble your parts and tools.
   For a list of required tools, see "Parts and tools" on page 12-1.

9. When you are ready to install the XR6/XR3 transmitter, follow the steps shown in Figure 1.1 on page 1-2.

TIP	When you have completed a task or step, put a check mark beside the step number.

CAUTION:
FAILURE TO COMPLY WITH RECOMMENDATIONS MAY VOID YOUR MANUFACTURER'S WARRANTY. FOR MORE INFORMATION, REVIEW YOUR WARRANTY DOCUMENTS.

Figure 1.1: Flowchart - Installing the transmitter



Section 2: Installing the power transformer

1. Before placing the transformer into the transmitter, set the line voltage tap selections. Based on your nominal line to line (or line to neutral for some single-phase ac power sources) voltage, select the appropriate tap position identified on the labels mounted on the terminal board end of the transformer. One label identifies the tap number and the line-to-line (or line-to-neutral) voltage. Another label identifies the tap. All phases must be set to the same tap (see also Figure 3.1 and Table 2.1 on page 2-3). If necessary, use the hardware already on each of the three copper straps to connect the straps to the new tap positions. Be sure to scrape any excess epoxy off the electrical joint area.

Transformer taps

Figure 2.1: Three-phase XR6 power transformer line voltage tap layout

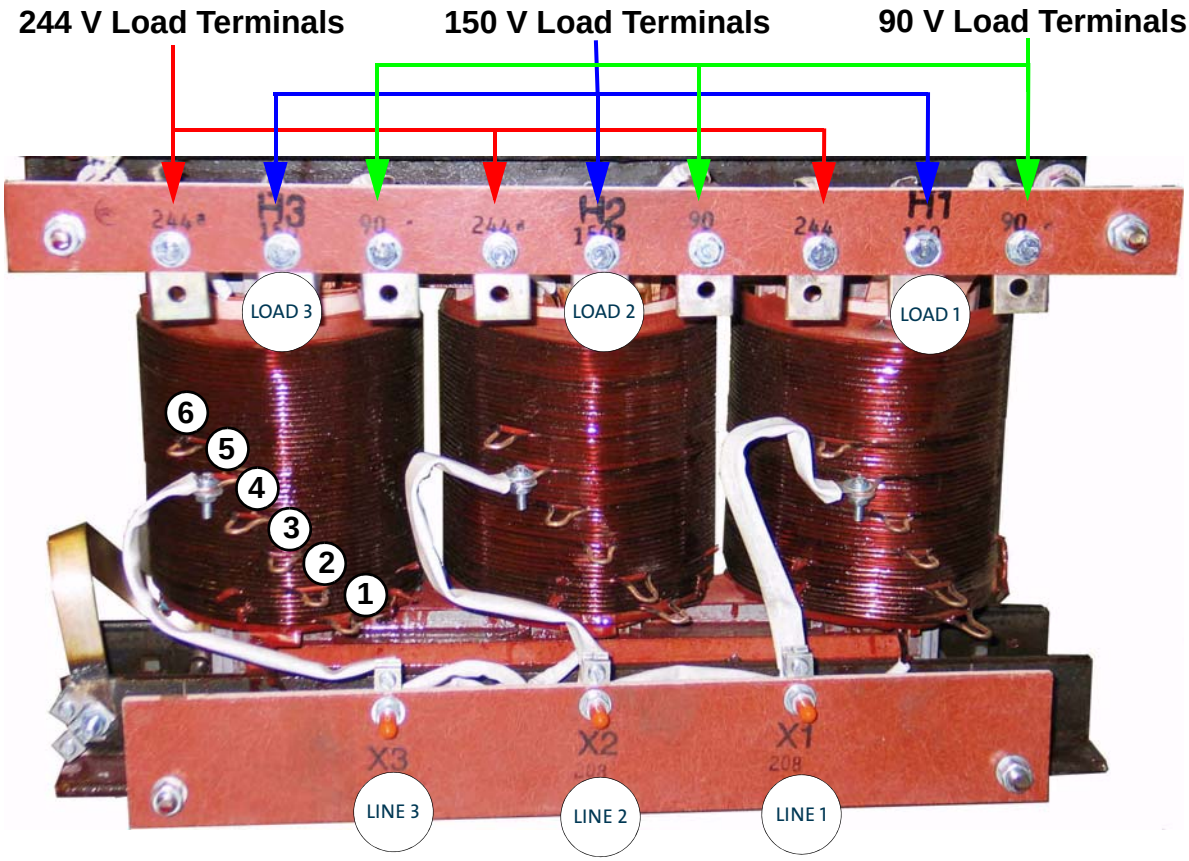


Figure 2.2: Single-phase XR6 power transformer line voltage tap layout

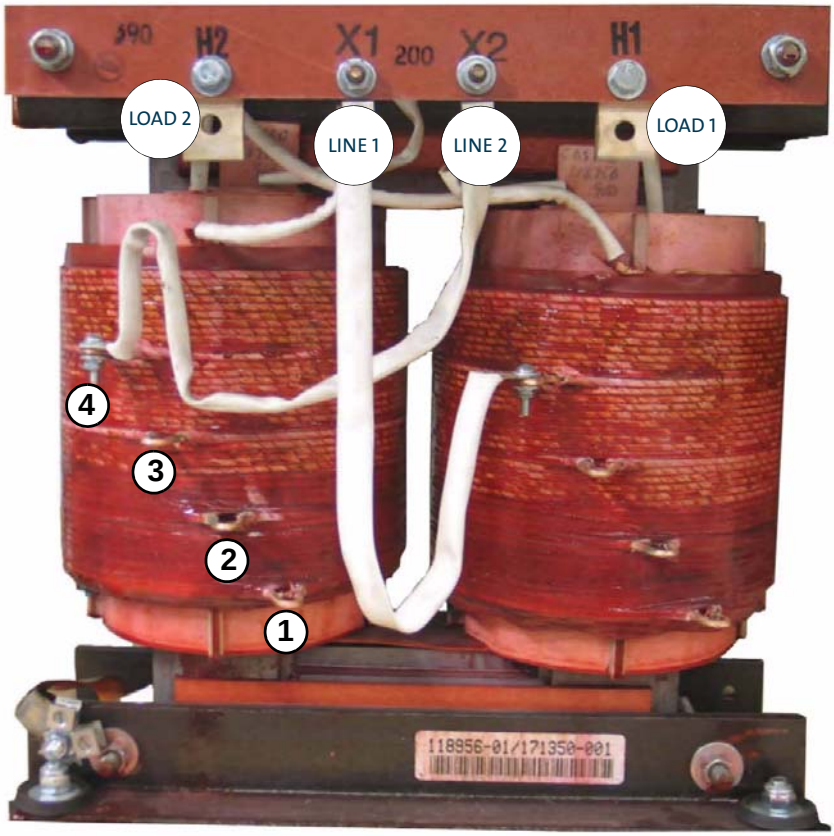


Table 2.1: Three-phase primary winding tap nominal voltages (rms, phase-to-phase)

Voltage (V ac)	Tap
198	6
208	5
218	4
229	3
239	2
250	1

or

Voltage (V ac)	Tap
342	6
361	5
380	4
399	3
418	2
437	1

Table 2.2: Single-phase primary winding tap nominal voltages (rms, phase-to-phase)

Voltage (V ac)	Tap
200	4
220	3
240	2
260	1

NOTE: Ac voltage applied to transformer taps can be phase-to-phase (L-L) or phase-to-neutral (L-N).

Perform this procedure as part of installing the transmitter.

WARNING:
The main power transformer weighs approximately 68 kg (150 lbs). Do not attempt to move it unless sufficient manpower or mechanical assistance is available to move it into position without damaging the cabinet or causing injury to personnel.

2. Remove the lower back cover from the transmitter.

3. Remove the back plate at the bottom/back of the transmitter cabinet by removing four mounting screws (see Figure 2.4 on page 2-5).

4. For single-phase transmitters only: Remove the four choke shims at the bottom of the tray supporting the three chokes. The shims are secured using M5 hardware (see Figure 2.3). Discard shims and hardware or retain for future shipping of the transmitter..

5. Position the power transformer assembly directly behind the cabinet, with its **Line**/**Load** terminals and voltage taps facing the right side, as viewed from the rear (see Figure 2.4).

6. With the help of an assistant, lift the end of the power transformer closest to the cabinet slightly, slide the transformer part way into the cabinet, then lower it onto the transmitter's bottom plate. Be sure to leave enough room to easily connect the **Line**, **Load** and **Transformer Ground** wires.

7. For three-phase transmitters, connect the nine wires terminated on contactors K1 and K2 to the transformer's **Load** terminals – **H1 90**, **H2 90**, **H3 90**, **H1 150**, **H2 150**, **H3 150**, **H1 244**, **H2 244**, and **H3 244**. Be sure to connect the wires to the correct load terminals, **90 V, 150 V** and **244 V**, as marked on the transformer (see Figure 2.1 on page 2-1). For single-phase transmitters, connect the two black, 6 AWG wires terminated on A14U1-1 and A14U2-1 to the transformer's **Load 1** and **Load 2** terminals respectively; connect the two black, 6 AWG wires terminated on A14U3-2 and TB1-1 to the transformer's **Line 1** and **Line 2** terminals respectively (see Figure 2.2 on page 2-2).

8. For three-phase transmitters, connect the ac line input to the **X1** (Line 1), **X2** (Line 2) and **X3** (Line 3) input terminals on the transformer (see Figure 2.1 on page 2-1). The ac ground will be connected later. For single-phase transmitters, connect the ac line input to TB1-2 (Line 1), TB1-1 (Line 2 or Neutral) and TB1-4 (ground), noting terminal block TB1 is in the lower, right part of the cabinet (see Figure 2.3 on page 2-5).

Figure 2.3: XR6/XR3 1-phase choke shim removal

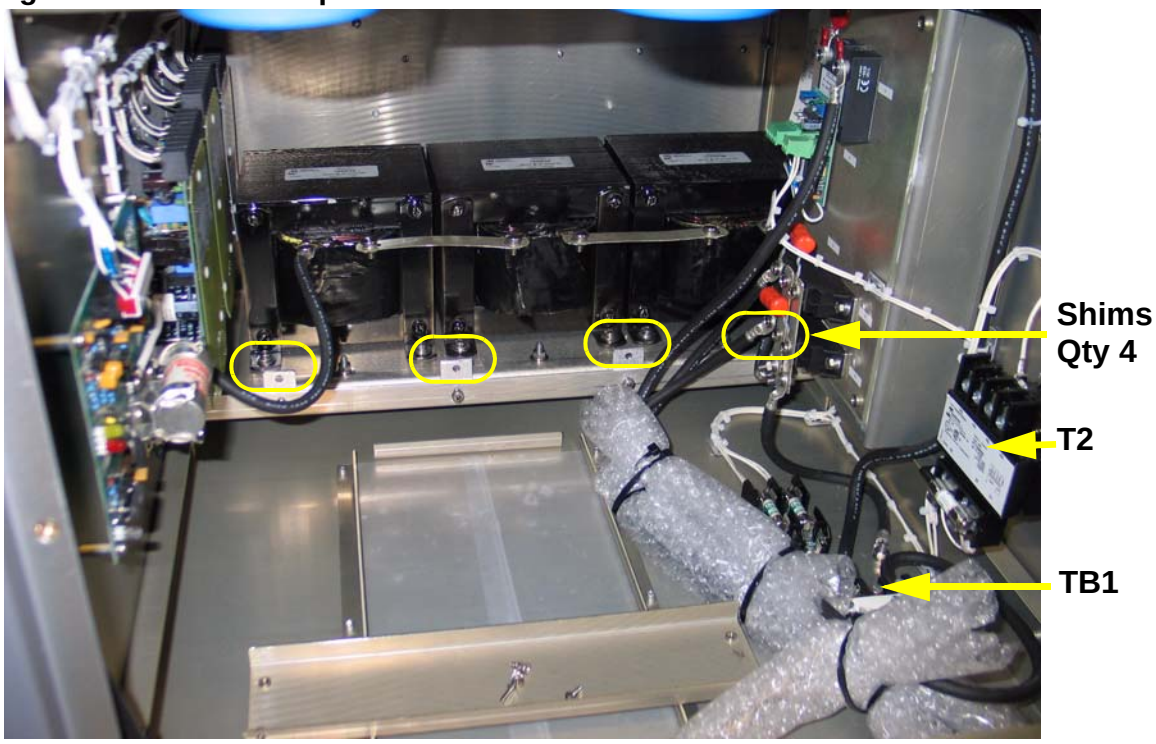


Figure 2.4: XR6/XR3 3-phase power transformer installation

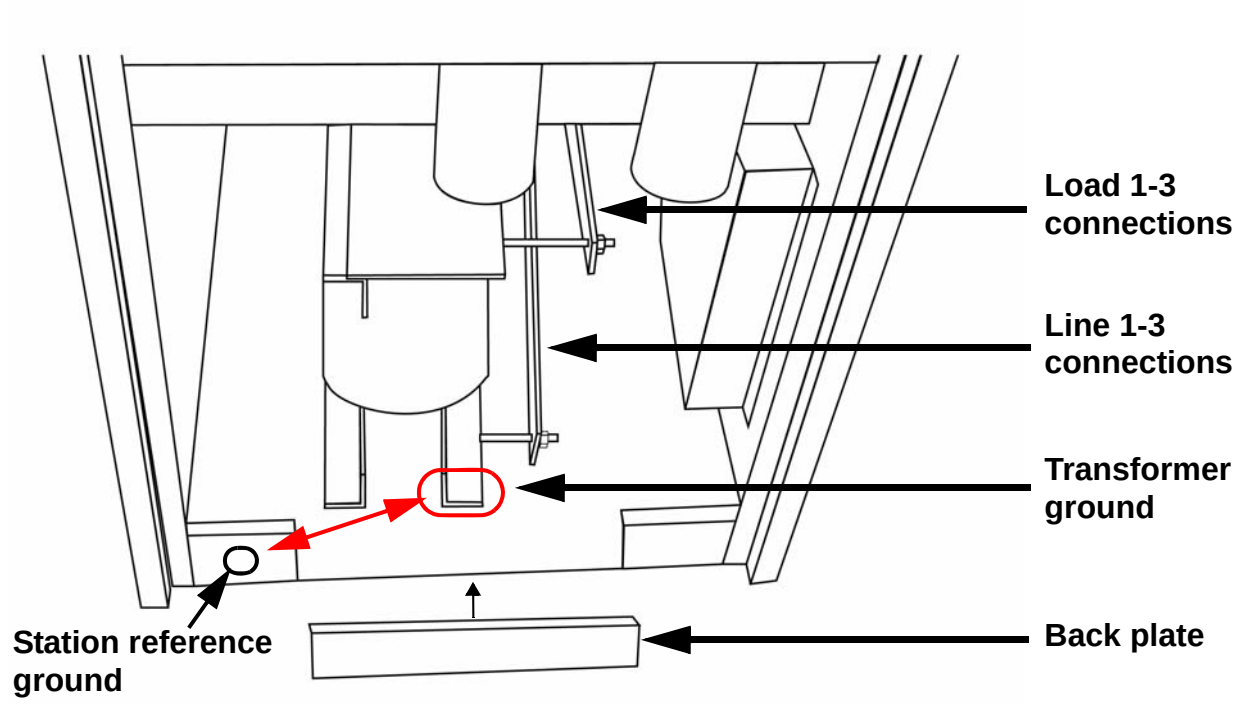
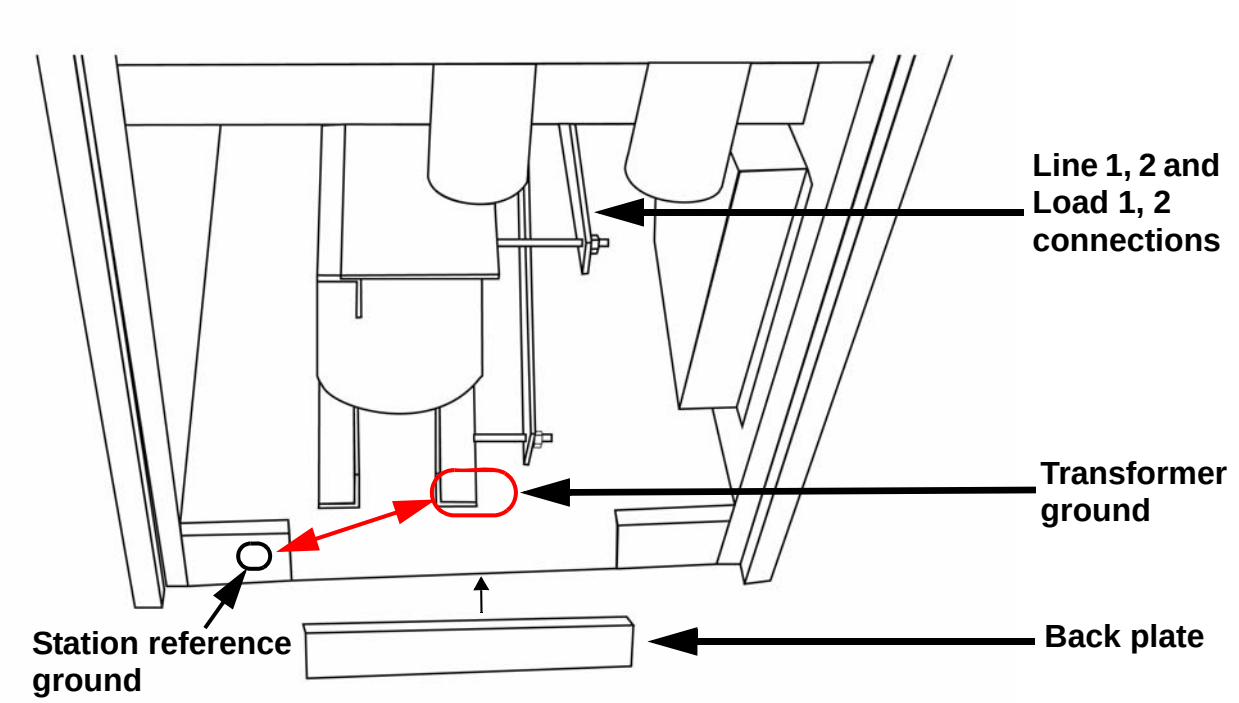


Figure 2.5: XR6/XR3 1-phase power transformer installation



9. Slide the transformer into its final position in the cabinet. Ensure that the anchor holes in the base of transformer line up with the anchor holes in the bottom of the transmitter.

10. Set the tap connections on control transformer T2, located on the right-hand wall of the transmitter (as viewed from the back, see Figure 2.3). Based on your nominal line to line (or line to neutral) voltage, select the tap position identified in Figure 2.6 that is closest to your voltage. If necessary, disconnect wire # 141 and secure it to the selected tap.

11. Reinstall the back plate using the four mounting screws removed in Step 3.

Figure 2.6: XR6/XR3 1-phase control transformer (T2) tap selection

L-L or L-N Voltage (V ac)	Wire #141 Tap
277	H4
240	H3
208	H2

Section 3: Unpacking and positioning

To install an XR6/XR3 transmitter, perform the following tasks:

1. Lift and slide the transmitter cabinet off the base of its crate.

2. If necessary, remove the power modules from the transmitter.
   Without the power transformer, and with one power module installed, the XR6/XR3 transmitter weighs about 145 kg (319 lbs).*

   * For XR6/XR3 transmitters, a second RF power module is optional.

CAUTION: An RF power module weighs approximately 20 kg (42 lbs.). Use care when lifting the module.

- Remove both of the transmitter's rear covers.

- Remove the packing bolt at the rear of each RF power module.
  See Figure 2.2 on page 2-3.

- Remove the connector under the front of each RF power module. See Figure 3.1 on page 3-2.

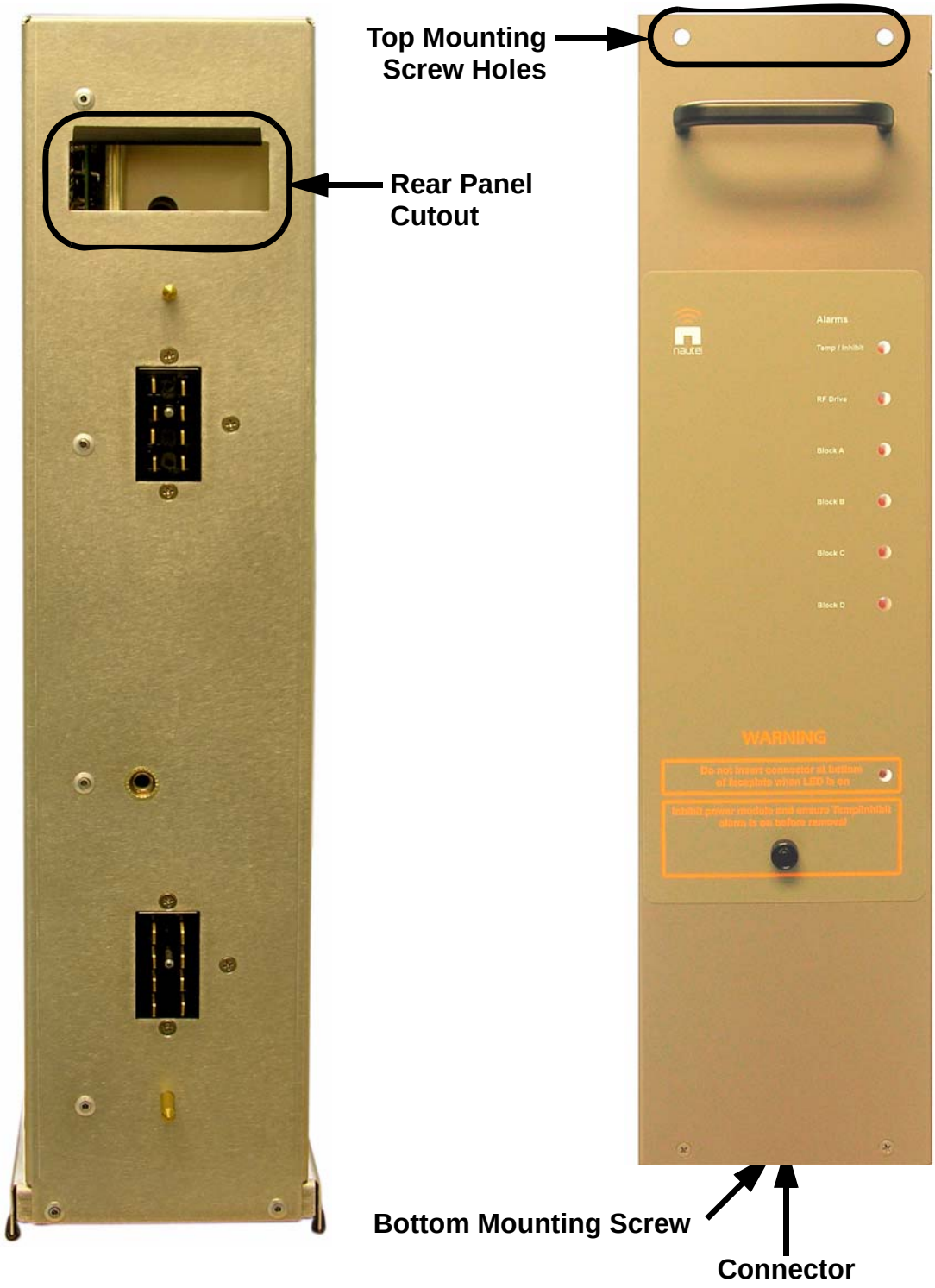
- Remove both top mounting screws, and the bottom mounting screw behind the connector, on the front of each RF power module. See Figure 3.1.

- Grasp an RF power module's handle and pull the module out through the front of the transmitter. Remove other RF power modules the same way.

  Note: As the RF power module slides out, there is a cutout in the top of the module's rear panel that can serve as a hand hold. See Figure 3.1.

- Store the RF power modules in a location where they will be safe from mechanical impact, dirt, dust, cold, heat, or weather, until you are ready to reinstall them.

Figure 3.1: RF Power Module

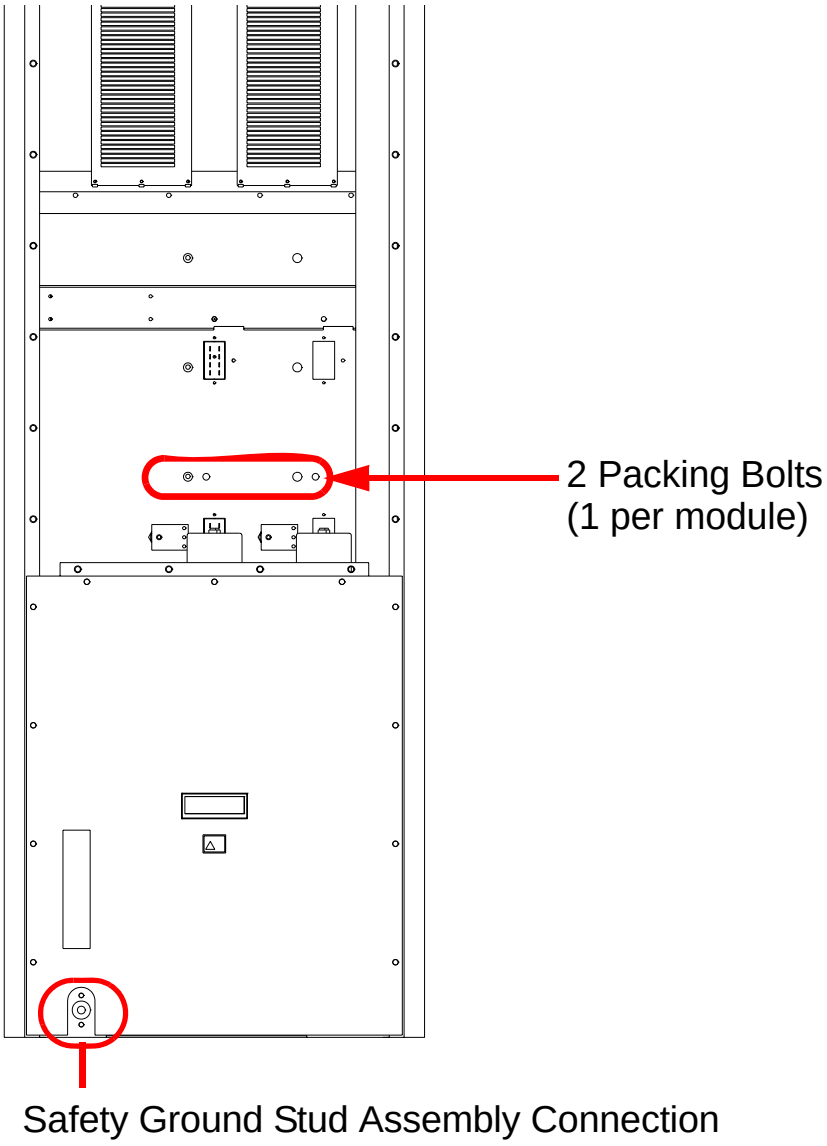


3. Move the transmitter cabinet to its assigned position.

4. Verify that the ac power cable conduit from the ac disconnect switch reaches the entry point in the cabinet.

5. Verify that the RF feed cable reaches the RF output connector on the cabinet.

Figure 3.2: XR6/XR3 Transmitter – Rear View



Section 4: Connecting the station reference ground

To connect the station reference ground, perform the following steps:

1. Locate the safety ground stud assembly. It has been set back in its final location at the bottom left rear of the transmitter..

2. Remove the two nuts holding it to the phenolic bar.

3. Re-assemble as shown in Figure 4.1. Attach a continuous, low impedance conductor (minimum four-inch copper strap, or equivalent) between the station reference ground and this stud assembly as shown. Firmly tighten all hardware. Ensure the reference ground wire is at least 3 mm (1/8 in) from the cabinet exterior.

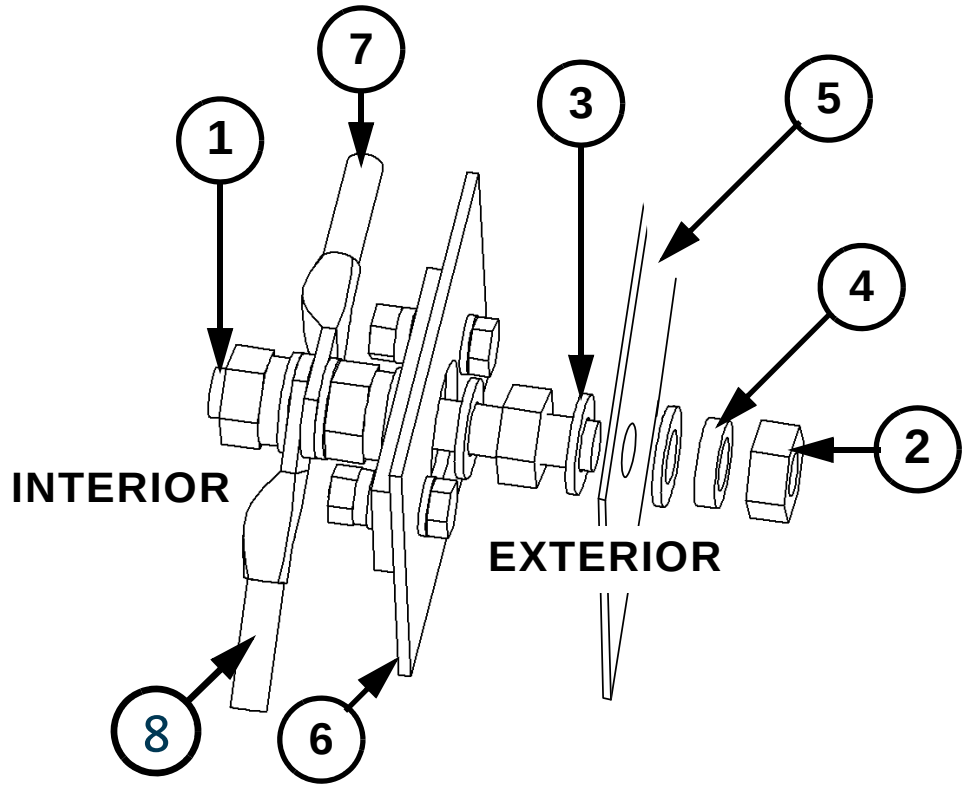
4. Attach the 6 AWG wire from the safety ground stud assembly to the transformer ground. See Figure 3.2 on page 3-3.

5. For information about grounding the lightning protection, see the *XR6/XR3 Pre-Installation Manual*.

   For detailed information about lightning protection, see the *Nautel Site Preparation Manual*, available from your Nautel sales agent, or online from the Nautel website.

6. Firmly tighten all nuts.

Figure 4.1: Safety Ground Stud Assembly Detail



1) M10 BRASS STUD
2) M10 NUT
3) M10 FLAT WASHER
4) M10 SPLIT WASHER
5) EXTERIOR REFERENCE GROUND CONDUCTOR
6) CABINET FRAME
7) TRANSFORMER GROUND WIRE
8) CABINET GROUND WIRE

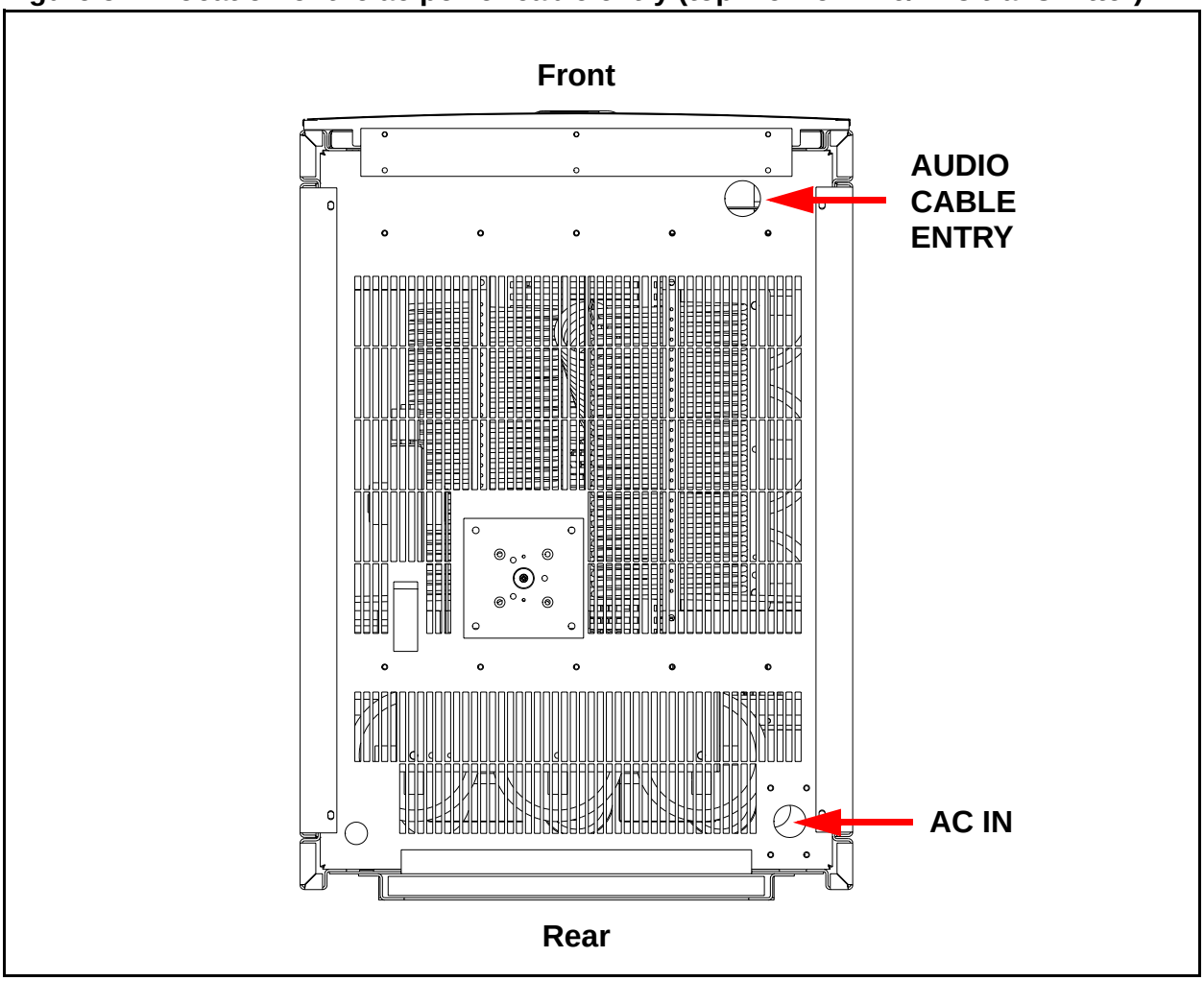
Section 5: Connecting ac power

To connect ac power to the transmitter, perform the following steps:

1. Run the ac power cable from the ac disconnect switch to the transmitter, passing all the conductors, as a group, through a ferrite toroid (provided in the ancillary kit). The preferred entry point is the top of the transmitter. Internal conduit is provided to guide the cable to the power supply space at the bottom of the transmitter (see Figure 5.1).

WARNING: Ensure that wiring sizes are appropriate. ac wiring must be installed by a qualified, locally-certified electrician.

Figure 5.1: Location of the ac power cable entry (top view of XR6/XR3 transmitter)



2. Connect the ac power ground to the station reference ground.

3. Verify that the station reference ground and the transformer ground terminal are connected to the safety ground stud assembly on the rear of the transmitter, (see Figure 2.2 on page 2-3 and Step 3 - Step 4, page 4-1).

4. Verify that the ac power conductors are connected to the power transformer as shown in Section 2, "Installing the power transformer" on page 2-1.

5. Optionally, install the NAX188 MOV ac transient protection system. See the NAX188 documentation for more information.

Section 6: Installing the RF connector

The XR6/XR3 comes with one of several types of RF output connectors. All types are illustrated in this section.

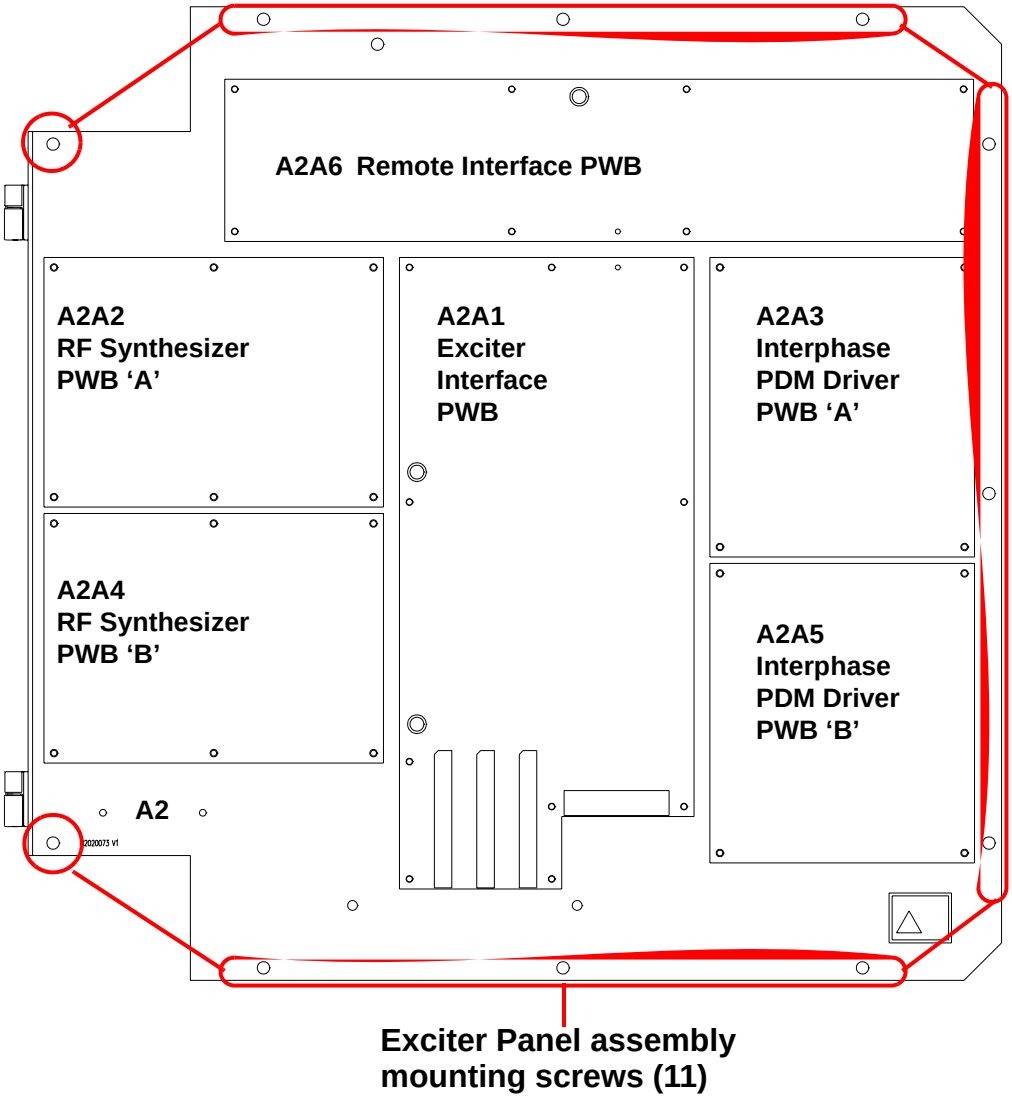
Preparation

WARNING:
THE AC VOLTAGES PRESENT IN THE TRANSMITTER CAN BE FATAL. EXERCISE EXTREME CAUTION.

1. Make sure that the ac power is turned off at the ac service entrance.
2. Gain access to the **Exciter Panel** assembly by opening the door containing the GUI and control panel on the front of the transmitter. The door is not latched and just swings open to the left.
3. Remove all 11 **Exciter Panel** assembly mounting screws (Figure 6.1 on page 6-2), then swing the **Exciter Panel** to the left to open it and expose the inside of the filter.
4. On the back wall of the filter, there is an **Output Strap** attached to one disc-shaped capacitor (e.g., see Figure 6.2 on page 6-3 and the Note below). Perform the steps in the following sections to install the appropriate RF output connector.
5. If you are proceeding to "Adjusting the spark gap" on page 7-1 after installing the RF connector, leave the **Exciter Panel** open until the completion of that procedure.

Note:
The filter components shown in the RF connector figures in this section are frequency-dependent. Therefore, the components used in your transmitter may not exactly match the components shown in the figures.

Figure 6.1: XR6/XR3 Exciter Panel Assembly (NAE93 – A2)



7/8 EIA Output Connection

1. Locate and unpack the output connector kit.

2. Attach the brass connector cup from the kit to the output strap using the M5 x 16 mm long hex head bolt, split washer and flat washer supplied, such that the cup is pointing towards the large hole in the top (Figure 6.2).

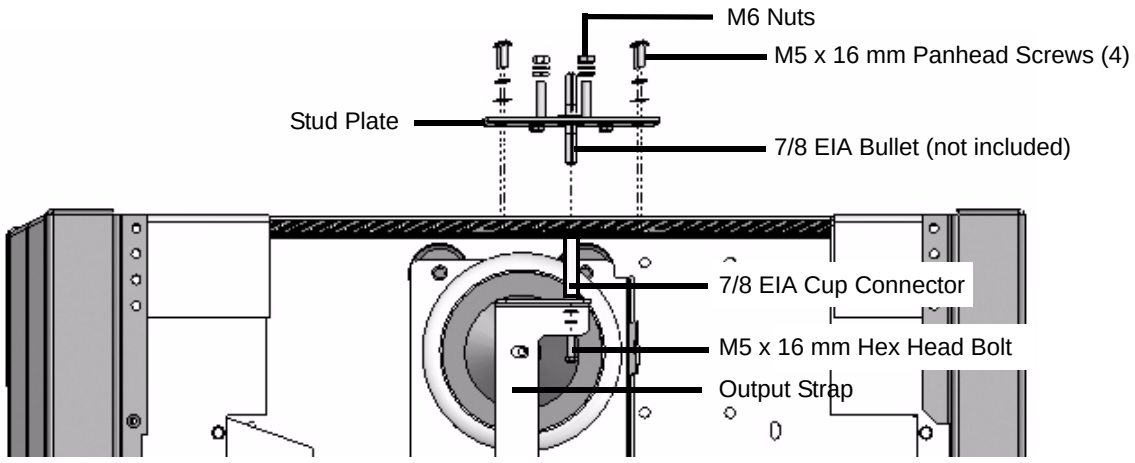
3. Position the stud plate on top of the transmitter over the large hole above the output strap and attach with the four supplied M5 x 16 mm long pan head screws, split and flat washers.

4. Insert a 7/8 EIA Bullet (not supplied) through the connector plate into the brass connector cup. Remove the three M6 nuts and washers from the stud plate and attach the output flange or coax connector (not supplied).

5. Close the Exciter Panel and reinstall all 11 mounting screws removed in "Preparation" on page 6-1.

6. Close the front panel.

Figure 6.2: 7/8 EIA Output Connection



1-5/8 EIA Output Connection

1. Locate and unpack the output connector kit.

2. Attach the brass connector cup from the kit to the output strap using the 5/16 x 1 inch long socket head cap screw, split washer and flat washer supplied, such that the cup is pointing towards the large hole in the top (Figure 6.3).

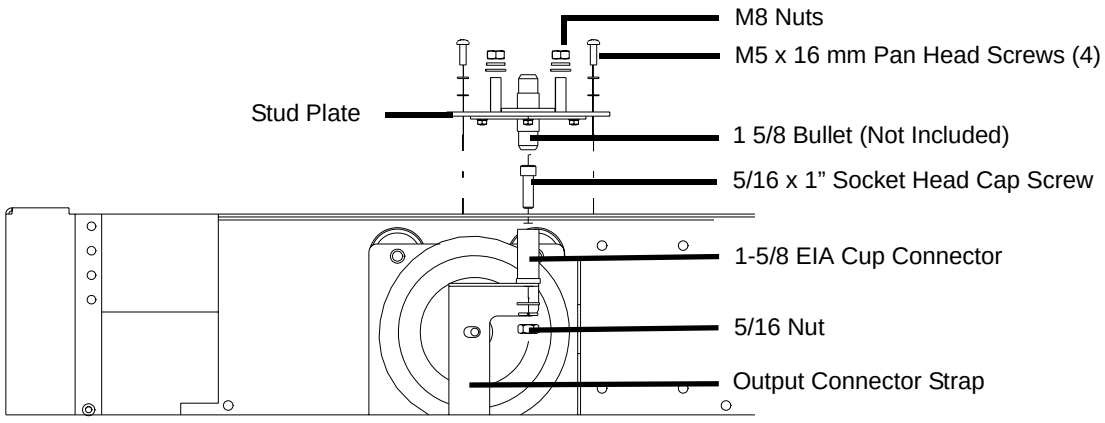
3. Position the stud plate on top of the transmitter over the large hole above the output strap and attach with the four supplied M5 x 16 mm long pan head screws, split and flat washers.

4. Insert a 1-5/8 EIA Bullet (not supplied) through the connector plate into the brass connector cup. Remove the four M8 nuts and washers from the stud plate and attach the output flange or coax connector (not supplied).

5. Close the Exciter Panel and reinstall all 11 mounting screws removed in "Preparation" on page 6-1.

6. Close the front panel.

Figure 6.3: 1-5/8 Output Connection



Stud Output Connector

1. Unpack the stud connector assembly. Remove the M6 nut, split washer and one flat washer off the longer leg of the brass stud in the stud plate (Figure 6.4).

2. Position the stud plate on top of the transmitter over the large hole above the output strap.

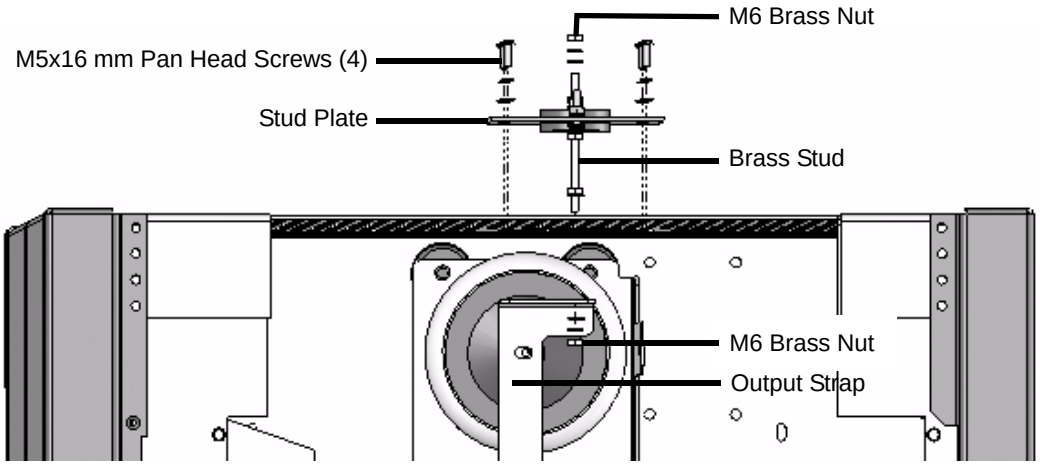
3. Slide the brass stud through the hole in the output strap and re-attach the M6 nut, split washer and flat washer.

4. Attach the stud plate on top of the transmitter with the four supplied M5 x 16 mm long pan head screws, split and flat washers.

5. Close the Exciter Panel and reinstall all 11 mounting screws removed in "Preparation" on page 6-1.

6. Close the front panel.

Figure 6.4: Stud-type Output Connector



Section 7: Adjusting the spark gap

The XR6/XR3's RF output filter contains a spark gap that must be adjusted - based on frequency and site altitude - to provide protection against excessive voltage (i.e., lightning) on the RF output.

If the altitude of the transmitter site is known prior to transmitter delivery, then the spark gap is adjusted at Nautel. If this is the case, it may only be necessary to verify the spark gap setting.

WARNING:
THE AC VOLTAGES PRESENT IN THE TRANSMITTER CAN BE FATAL. EXERCISE EXTREME CAUTION.

1. Determine the frequency of the transmitter (in kHz)
2. Determine the altitude of the transmitter site (in feet).
3. Make sure that the ac power is turned off at the ac service entrance.
4. Gain access to the RF output spark gap, noting it is in the same vicinity as the RF output connector (see "Preparation" on page 6-1).
5. Locate spark gap E1 (see Figure 7.1 on page 7-2). Measure the air gap between the spark gap balls, using a feeler gauge.
6. The air gap should be the distance listed in Table 7.1, "Spark Gap Setting versus Altitude" for the carrier frequency (use the closest frequency except where the Note below differs) multiplied by the scale factor listed in Table 7.2, "Altitude Scale Factor" on page 7-11 for the altitude determined in Step 2. If not, loosen the locking nut on the spark gap, adjust the position of the spark gap ball for the required gap and then tighten the locking nut.

Note:
Between certain 1 kHz increments there is a considerable difference in air gap. If your frequency is 663 kHz, use the gap setting for 660 kHz. If your frequency is 664kHz, use the gap setting for 665 kHz. If your frequency is 1243 kHz, use the gap setting for 1240 kHz. If your frequency is 1244 kHz, use the gap setting for 1245 kHz.

7. Close access to the RF output filter's access panel (see "Preparation" on page 6-1).

Figure 7.1: RF Output Spark Gap Location

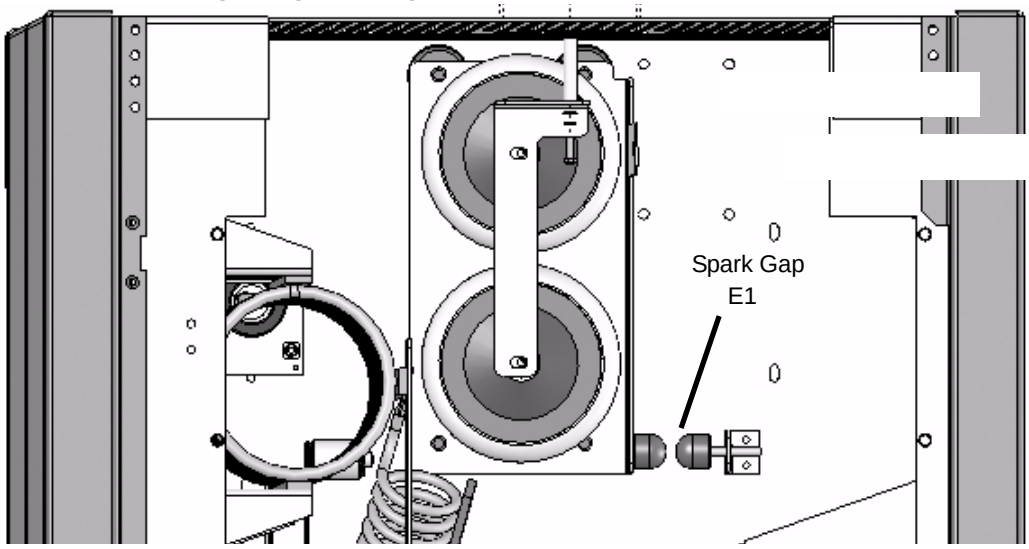


Table 7.1: Spark Gap Setting versus Altitude

Frequency (kHz)	Spark Gap (in.) @ 0 ft. Altitude
530	0.050 (XR3) 0.079 (XR6)
535	0.049 (XR3) 0.078 (XR6)
540	0.049 (XR3) 0.077 (XR6)
545	0.048 (XR3) 0.077 (XR6)
550	0.048 (XR3) 0.076 (XR6)
555	0.047 (XR3) 0.075 (XR6)
560	0.047 (XR3) 0.074 (XR6)
565	0.046 (XR3) 0.074 (XR6)
570	0.046 (XR3) 0.073 (XR6)
575	0.046 (XR3) 0.072 (XR6)
580	0.045 (XR3) 0.072 (XR6)
585	0.045 (XR3) 0.071 (XR6)
590	0.044 (XR3) 0.071 (XR6)
595	0.044 (XR3) 0.070 (XR6)
600	0.044 (XR3) 0.069 (XR6)
605	0.043 (XR3) 0.069 (XR6)
610	0.043 (XR3) 0.069 (XR6)
615	0.043 (XR3) 0.068 (XR6)
620	0.042 (XR3) 0.067 (XR6)
625	0.042 (XR3) 0.067 (XR6)
630	0.042 (XR3) 0.066 (XR6)
635	0.041 (XR3) 0.066 (XR6)
640	0.041 (XR3) 0.065 (XR6)
645	0.041 (XR3) 0.065 (XR6)
650	0.040 (XR3) 0.064 (XR6)
655	0.040 (XR3) 0.064 (XR6)
660	0.040 (XR3) 0.063 (XR6)
665	0.079 (XR3) 0.125 (XR6)
670	0.078 (XR3) 0.124 (XR6)
675	0.077 (XR3) 0.123 (XR6)

Table 7.1: Spark Gap Setting versus Altitude (continued)

Frequency (kHz)	Spark Gap (in.) @ 0 ft. Altitude
680	0.076 (XR3) 0.122 (XR6)
685	0.076 (XR3) 0.121 (XR6)
690	0.075 (XR3) 0.120 (XR6)
695	0.075 (XR3) 0.119 (XR6)
700	0.074 (XR3) 0.118 (XR6)
705	0.073 (XR3) 0.117 (XR6)
710	0.073 (XR3) 0.116 (XR6)
715	0.072 (XR3) 0.115 (XR6)
720	0.071 (XR3) 0.114 (XR6)
725	0.071 (XR3) 0.113 (XR6)
730	0.070 (XR3) 0.112 (XR6)
735	0.070 (XR3) 0.111 (XR6)
740	0.069 (XR3) 0.110 (XR6)
745	0.069 (XR3) 0.109 (XR6)
750	0.068 (XR3) 0.108 (XR6)
755	0.068 (XR3) 0.108 (XR6)
760	0.067 (XR3) 0.107 (XR6)
765	0.067 (XR3) 0.106 (XR6)
770	0.066 (XR3) 0.105 (XR6)
775	0.066 (XR3) 0.104 (XR6)
780	0.065 (XR3) 0.104 (XR6)
785	0.065 (XR3) 0.103 (XR6)
790	0.064 (XR3) 0.102 (XR6)
795	0.064 (XR3) 0.101 (XR6)
800	0.063 (XR3) 0.100 (XR6)
805	0.063 (XR3) 0.100 (XR6)
810	0.062 (XR3) 0.099 (XR6)
815	0.062 (XR3) 0.098 (XR6)
820	0.061 (XR3) 0.098 (XR6)
825	0.061 (XR3) 0.097 (XR6)

Table 7.1: Spark Gap Setting versus Altitude (continued)

Frequency (kHz)	Spark Gap (in.) @ 0 ft. Altitude
830	0.061 (XR3) 0.096 (XR6)
835	0.060 (XR3) 0.096 (XR6)
840	0.060 (XR3) 0.095 (XR6)
845	0.059 (XR3) 0.095 (XR6)
850	0.059 (XR3) 0.094 (XR6)
855	0.059 (XR3) 0.093 (XR6)
860	0.058 (XR3) 0.093 (XR6)
865	0.058 (XR3) 0.092 (XR6)
870	0.057 (XR3) 0.091 (XR6)
875	0.057 (XR3) 0.091 (XR6)
880	0.057 (XR3) 0.090 (XR6)
885	0.056 (XR3) 0.090 (XR6)
890	0.056 (XR3) 0.089 (XR6)
895	0.056 (XR3) 0.088 (XR6)
900	0.055 (XR3) 0.088 (XR6)
905	0.055 (XR3) 0.087 (XR6)
910	0.055 (XR3) 0.087 (XR6)
915	0.054 (XR3) 0.086 (XR6)
920	0.054 (XR3) 0.086 (XR6)
925	0.054 (XR3) 0.085 (XR6)
930	0.053 (XR3) 0.085 (XR6)
935	0.053 (XR3) 0.084 (XR6)
940	0.053 (XR3) 0.084 (XR6)
945	0.052 (XR3) 0.083 (XR6)
950	0.052 (XR3) 0.083 (XR6)
955	0.052 (XR3) 0.082 (XR6)
960	0.052 (XR3) 0.082 (XR6)
965	0.051 (XR3) 0.081 (XR6)
970	0.051 (XR3) 0.081 (XR6)
975	0.051 (XR3) 0.081 (XR6)

Table 7.1: Spark Gap Setting versus Altitude (continued)

Frequency (kHz)	Spark Gap (in.) @ 0 ft. Altitude
980	0.050 (XR3) 0.080 (XR6)
985	0.050 (XR3) 0.080 (XR6)
990	0.050 (XR3) 0.079 (XR6)
995	0.050 (XR3) 0.079 (XR6)
1000	0.049 (XR3) 0.078 (XR6)
1005	0.049 (XR3) 0.078 (XR6)
1010	0.049 (XR3) 0.078 (XR6)
1015	0.049 (XR3) 0.077 (XR6)
1020	0.048 (XR3) 0.077 (XR6)
1025	0.048 (XR3) 0.076 (XR6)
1030	0.048 (XR3) 0.076 (XR6)
1035	0.048 (XR3) 0.076 (XR6)
1040	0.047 (XR3) 0.075 (XR6)
1045	0.047 (XR3) 0.075 (XR6)
1050	0.047 (XR3) 0.074 (XR6)
1055	0.047 (XR3) 0.074 (XR6)
1060	0.046 (XR3) 0.074 (XR6)
1065	0.046 (XR3) 0.073 (XR6)
1070	0.046 (XR3) 0.073 (XR6)
1075	0.046 (XR3) 0.073 (XR6)
1080	0.045 (XR3) 0.072 (XR6)
1085	0.045 (XR3) 0.072 (XR6)
1090	0.045 (XR3) 0.072 (XR6)
1095	0.045 (XR3) 0.071 (XR6)
1100	0.045 (XR3) 0.071 (XR6)
1105	0.044 (XR3) 0.071 (XR6)
1110	0.044 (XR3) 0.070 (XR6)
1115	0.044 (XR3) 0.070 (XR6)
1120	0.044 (XR3) 0.070 (XR6)
1125	0.044 (XR3) 0.069 (XR6)

Table 7.1: Spark Gap Setting versus Altitude (continued)

Frequency (kHz)	Spark Gap (in.) @ 0 ft. Altitude
1130	0.043 (XR3) 0.069 (XR6)
1135	0.043 (XR3) 0.069 (XR6)
1140	0.043 (XR3) 0.068 (XR6)
1145	0.043 (XR3) 0.068 (XR6)
1150	0.043 (XR3) 0.068 (XR6)
1155	0.042 (XR3) 0.068 (XR6)
1160	0.042 (XR3) 0.067 (XR6)
1165	0.042 (XR3) 0.067 (XR6)
1170	0.042 (XR3) 0.067 (XR6)
1175	0.042 (XR3) 0.066 (XR6)
1180	0.042 (XR3) 0.066 (XR6)
1185	0.041 (XR3) 0.066 (XR6)
1190	0.041 (XR3) 0.066 (XR6)
1195	0.041 (XR3) 0.065 (XR6)
1200	0.041 (XR3) 0.065 (XR6)
1205	0.041 (XR3) 0.065 (XR6)
1210	0.041 (XR3) 0.064 (XR6)
1215	0.040 (XR3) 0.064 (XR6)
1220	0.040 (XR3) 0.064 (XR6)
1225	0.040 (XR3) 0.064 (XR6)
1230	0.040 (XR3) 0.063 (XR6)
1235	0.040 (XR3) 0.063 (XR6)
1240	0.040 (XR3) 0.063 (XR6)
1245	0.085 (XR3) 0.136 (XR6)
1250	0.085 (XR3) 0.135 (XR6)
1255	0.084 (XR3) 0.135 (XR6)
1260	0.084 (XR3) 0.134 (XR6)
1265	0.083 (XR3) 0.133 (XR6)
1270	0.083 (XR3) 0.133 (XR6)
1275	0.083 (XR3) 0.132 (XR6)

Table 7.1: Spark Gap Setting versus Altitude (continued)

Frequency (kHz)	Spark Gap (in.) @ 0 ft. Altitude
1280	0.082 (XR3) 0.131 (XR6)
1285	0.082 (XR3) 0.131 (XR6)
1290	0.082 (XR3) 0.130 (XR6)
1295	0.081 (XR3) 0.130 (XR6)
1300	0.081 (XR3) 0.129 (XR6)
1305	0.080 (XR3) 0.128 (XR6)
1310	0.080 (XR3) 0.128 (XR6)
1315	0.080 (XR3) 0.127 (XR6)
1320	0.079 (XR3) 0.126 (XR6)
1325	0.079 (XR3) 0.126 (XR6)
1330	0.079 (XR3) 0.125 (XR6)
1335	0.078 (XR3) 0.125 (XR6)
1340	0.078 (XR3) 0.124 (XR6)
1345	0.078 (XR3) 0.124 (XR6)
1350	0.077 (XR3) 0.123 (XR6)
1355	0.077 (XR3) 0.123 (XR6)
1360	0.076 (XR3) 0.122 (XR6)
1365	0.076 (XR3) 0.121 (XR6)
1370	0.076 (XR3) 0.121 (XR6)
1375	0.076 (XR3) 0.120 (XR6)
1380	0.075 (XR3) 0.120 (XR6)
1385	0.075 (XR3) 0.119 (XR6)
1390	0.075 (XR3) 0.119 (XR6)
1395	0.074 (XR3) 0.118 (XR6)
1400	0.074 (XR3) 0.118 (XR6)
1405	0.074 (XR3) 0.117 (XR6)
1410	0.073 (XR3) 0.117 (XR6)
1415	0.073 (XR3) 0.116 (XR6)
1420	0.073 (XR3) 0.116 (XR6)
1425	0.072 (XR3) 0.115 (XR6)

Table 7.1: Spark Gap Setting versus Altitude (continued)

Frequency (kHz)	Spark Gap (in.) @ 0 ft. Altitude
1430	0.072 (XR3) 0.115 (XR6)
1435	0.072 (XR3) 0.114 (XR6)
1440	0.071 (XR3) 0.114 (XR6)
1445	0.071 (XR3) 0.113 (XR6)
1450	0.071 (XR3) 0.113 (XR6)
1455	0.071 (XR3) 0.112 (XR6)
1460	0.070 (XR3) 0.112 (XR6)
1465	0.070 (XR3) 0.112 (XR6)
1470	0.070 (XR3) 0.111 (XR6)
1475	0.069 (XR3) 0.111 (XR6)
1480	0.069 (XR3) 0.110 (XR6)
1485	0.069 (XR3) 0.110 (XR6)
1490	0.069 (XR3) 0.109 (XR6)
1495	0.068 (XR3) 0.109 (XR6)
1500	0.068 (XR3) 0.108 (XR6)
1505	0.068 (XR3) 0.108 (XR6)
1510	0.068 (XR3) 0.108 (XR6)
1515	0.067 (XR3) 0.107 (XR6)
1520	0.067 (XR3) 0.107 (XR6)
1525	0.067 (XR3) 0.106 (XR6)
1530	0.067 (XR3) 0.106 (XR6)
1535	0.066 (XR3) 0.106 (XR6)
1540	0.066 (XR3) 0.105 (XR6)
1545	0.066 (XR3) 0.105 (XR6)
1550	0.066 (XR3) 0.104 (XR6)
1555	0.065 (XR3) 0.104 (XR6)
1560	0.065 (XR3) 0.104 (XR6)
1565	0.065 (XR3) 0.103 (XR6)
1570	0.065 (XR3) 0.103 (XR6)
1575	0.064 (XR3) 0.102 (XR6)

Table 7.1: Spark Gap Setting versus Altitude (continued)

Frequency (kHz)	Spark Gap (in.) @ 0 ft. Altitude
1580	0.064 (XR3) 0.102 (XR6)
1585	0.064 (XR3) 0.102 (XR6)
1590	0.064 (XR3) 0.101 (XR6)
1595	0.063 (XR3) 0.101 (XR6)
1600	0.063 (XR3) 0.101 (XR6)
1605	0.063 (XR3) 0.100 (XR6)
1610	0.063 (XR3) 0.100 (XR6)
1615	0.063 (XR3) 0.099 (XR6)
1620	0.062 (XR3) 0.099 (XR6)
1625	0.062 (XR3) 0.099 (XR6)
1630	0.062 (XR3) 0.098 (XR6)
1635	0.062 (XR3) 0.098 (XR6)
1640	0.061 (XR3) 0.098 (XR6)
1645	0.061 (XR3) 0.097 (XR6)
1650	0.061 (XR3) 0.097 (XR6)
1655	0.061 (XR3) 0.097 (XR6)
1660	0.061 (XR3) 0.096 (XR6)
1665	0.060 (XR3) 0.096 (XR6)
1670	0.060 (XR3) 0.096 (XR6)
1675	0.060 (XR3) 0.095 (XR6)
1680	0.060 (XR3) 0.095 (XR6)
1685	0.060 (XR3) 0.095 (XR6)
1690	0.059 (XR3) 0.094 (XR6)
1695	0.059 (XR3) 0.094 (XR6)
1700	0.059 (XR3) 0.094 (XR6)
1705	0.059 (XR3) 0.093 (XR6)

Table 7.2: Altitude Scale Factor

Altitude (ft) Spark Gap (in.)	Spark Gap Scale Factor (multiply gap by...)
0	1.00
1,000	1.05
2,000	1.10
3,000	1.15 (XR3), 1.16 (XR6)
4,000	1.21 (XR3), 1.22 (XR6)
5,000	1.28 (XR3), 1.29 (XR6)
6,000	1.35 (XR3), 1.36 (XR6)
7,000	1.43 (XR3), 1.45 (XR6)
8,000	1.52 (XR3), 1.54(XR6)
9,000	1.62 (XR3), 1.65 (XR6)
10,000	1.73 (XR3), 1.77 (XR6)

Section 8: Audio and IBOC inputs

This section describes requirements associated with audio feeds to the XR6/XR3 transmitter. This section includes the following topics:

Analog audio

Modulating audio must be applied from an external source. The RF drive source configuration determines the audio requirements. The audio source must be balanced, able to drive a 600 Ω load, and have a level between 0 and +12 dBm for 100% modulation.

Only one analog input is provided. Program content from the input is applied to either one or both exciters when they are configured for analog operation.

The transmitter does not have any audio processing capability. Use an external audio processor to ensure that the audio source material is processed properly. The audio processor adjusts the dynamic range, loudness, frequency response and symmetry parameters to suit the transmission system. Carefully control the peak levels.

For monaural applications, the audio may be processed to provide up to 145% positive peak program modulation, with a 3 kW (XR3) or 6 kW (XR6) RF carrier at the nominal ac voltage.

IBOC input

In Band On Channel (IBOC) audio is processed outside the XR6/XR3 in the customer's IBOC generator – a separate, standalone system that feeds an IBOC signal to the transmitter's mag and phase ports.

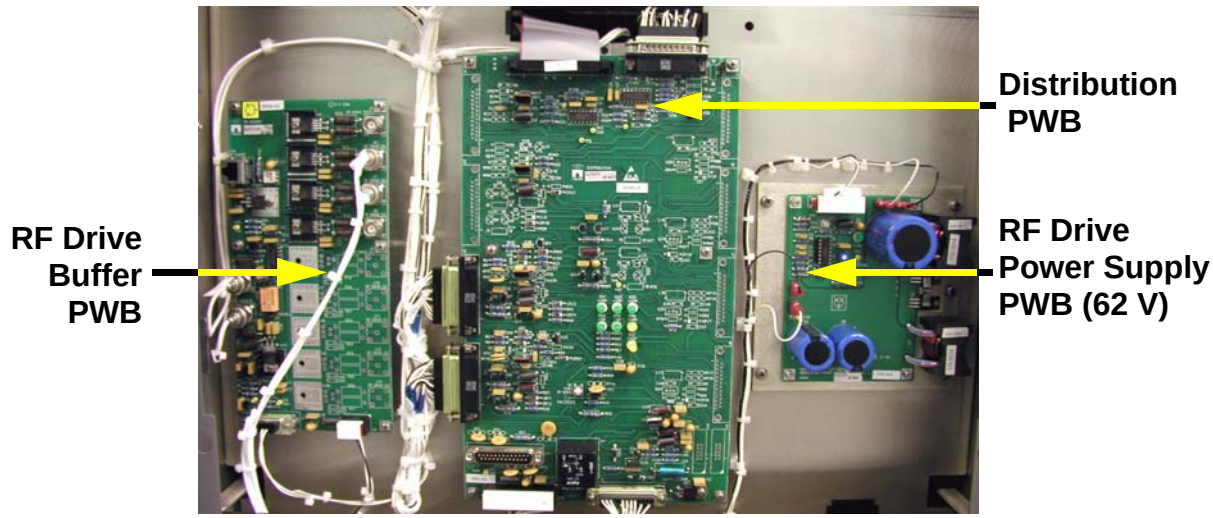
- Position the IBOC equipment close to the transmitter to minimize cable lengths.
- IBOC audio must be AES-EBU digital. Refer to the NE-IBOC documentation for more information.

Audio Configuration

1. To configure an analog installation, go to "Analog Configuration" below.

2. To configure an IBOC installation, choose which exciter you will configure for analog operation (A or B), and which you will configure for IBOC operation, then go to "IBOC Configuration" on page 8-3.

Figure 8.1: RF Drive Panel



Analog Configuration

By default, both exciters are configured for analog operation as follows. See Figure 8.1 and Figure 8.2 (a detail of the RF drive buffer PWB schematic in the *XR6/XR3 Troubleshooting Manual*).

1. E3 on the RF drive buffer PWB is set to HI to select high sensitivity.

2. On the RF drive buffer PWB, E1 and E2 are both set to Int.

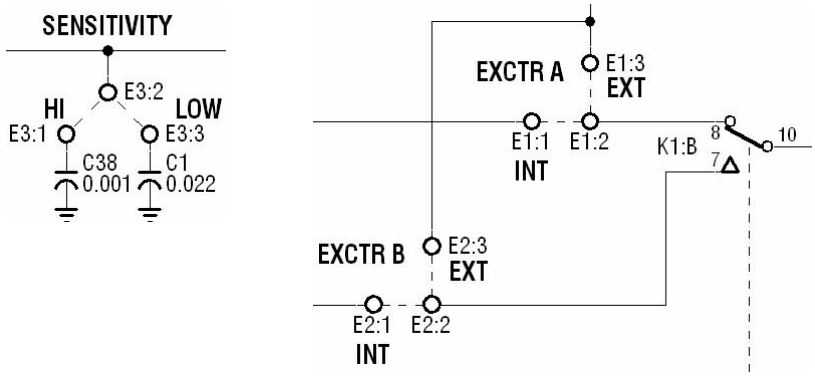
3. On the remote interface PWB, J3-23 and J3-25 should both be open circuit. See electrical schematic SD-1 in the *XR6/XR3 Troubleshooting Manual*.

Routing Analog Installation Cables

1. Route audio cables through the cable entry hole in the transmitter's top panel. See Figure 8.3 on page 8-6.

2. Route the cables through the ferrite toroid, provided in the ancillary kit, then toward the remote interface PWB, behind the GUI panel (see Figure 6.3 on page 6-4).

Figure 8.2: RF Drive Buffer PWB Details – IBOC Configuration



Connections for an analog installation

1. Connect the audio input to **TB2** on the remote interface PWB, behind the GUI panel.

2. Ensure correct signal polarity for the **TB2** connections in order to attain proper asymmetrical modulation: **TB2-1** is positive, **TB2-3** is negative, and **TB2-2** is ground.

> Note: How you connect the audio cables' shield depends on the presence or absence of ground loops. In some installations, you may need to connect the shield at one end only. In such cases, connect the end that provides the best results.

IBOC Configuration

To ensure maximum reliability of the main analog program, the recommended installation is to configure Exciter A for IBOC operation, and to configure Exciter B for analog operation.

- If both exciters are driven from the NE-IBOC, the NE-IBOC becomes a potential single point of failure in the system.

- If you provide a backup analog program stream to an exciter configured as *analog* in an IBOC installation, the system can automatically switch to the backup analog exciter and audio program stream. Refer to the *XR6/XR3 Operating and Maintenance Manual* for information about setting up exciter changeover.

Configuring Exciter A for IBOC

See Figure 8.1 on page 8-2 and Figure 8.2 on page 8-3.

1. On the remote interface PWB, set the **IBOC Input Select A** input to single-ended configuration by setting **E19** to **2-3**.

2. On the remote interface PWB, connect a jumper from **J3-23** to ground (**TB2-4**) permanently (or through the remote system), and set **J3-25** to open circuit. This will enable the IBOC inputs on **Exciter A**. A connector shell and solder pins for **J3** are provided in the ancillary kit.

3. On the RF drive buffer PWB, set **E3** to **Low** to select low sensitivity by shorting pins 2 and 3.

4. On the RF drive buffer PWB, set **E1** to **Ext** by shorting pins 2 and 3, and **E2** to **Int** by shorting pins 1 and 2.

Configuring Exciter B for IBOC

See Figure 8.1 on page 8-2 and Figure 8.2 on page 8-3.

1. On the remote interface PWB, set the **IBOC Input Select B** input to single-ended configuration by setting **E19** to **2-3**.

2. On the remote interface PWB, connect a jumper from **J3-25** to ground (**TB2-4**) permanently (or through the remote system), and set **J3-23** to open circuit. This will enable the IBOC inputs on **Exciter B**. A connecter shell and solder pins for **J3** are provided in the ancillary kit.

3. On the RF drive buffer PWB, set **E3** to **Low** to select low sensitivity by shorting pins 2 and 3.

4. On the RF drive buffer PWB, set **E1** to **Int** by shorting pins 1 and 2, and **E2** to **Ext** by shorting pins 2 and 3.

Configuring both Exciter A and B for IBOC

See Figure 8.1 on page 8-2 and Figure 8.2 on page 8-3.

- If both exciters are driven from the NE-IBOC, the NE-IBOC becomes a potential single point of failure in the system. See "IBOC Configuration" on page 8-3.

1. On the remote interface PWB, set the **IBOC Input Select A** and the **IBOC Input Select B** inputs to single-ended configuration by setting **E19** to **2-3**.

2. On the remote interface PWB, connect a jumper from J3-23, and a jumper from J3-25 to ground (TB2-4) permanently (or through the remote system). This will enable the IBOC inputs on Exciter A and B. A connecter shell and solder pins for J3 are provided in the ancillary kit.

3. On the RF drive buffer PWB, set E3 to Low to select low sensitivity by shorting pins 2 and 3.

4. On the RF drive buffer PWB, set E1 and E2 to Ext, by shorting pins 2 and 3.

Routing IBOC Installation Cables

1. Route IBOC cables through the cable entry hole in the transmitter's top panel. See Figure 8.3 on page 8-6).

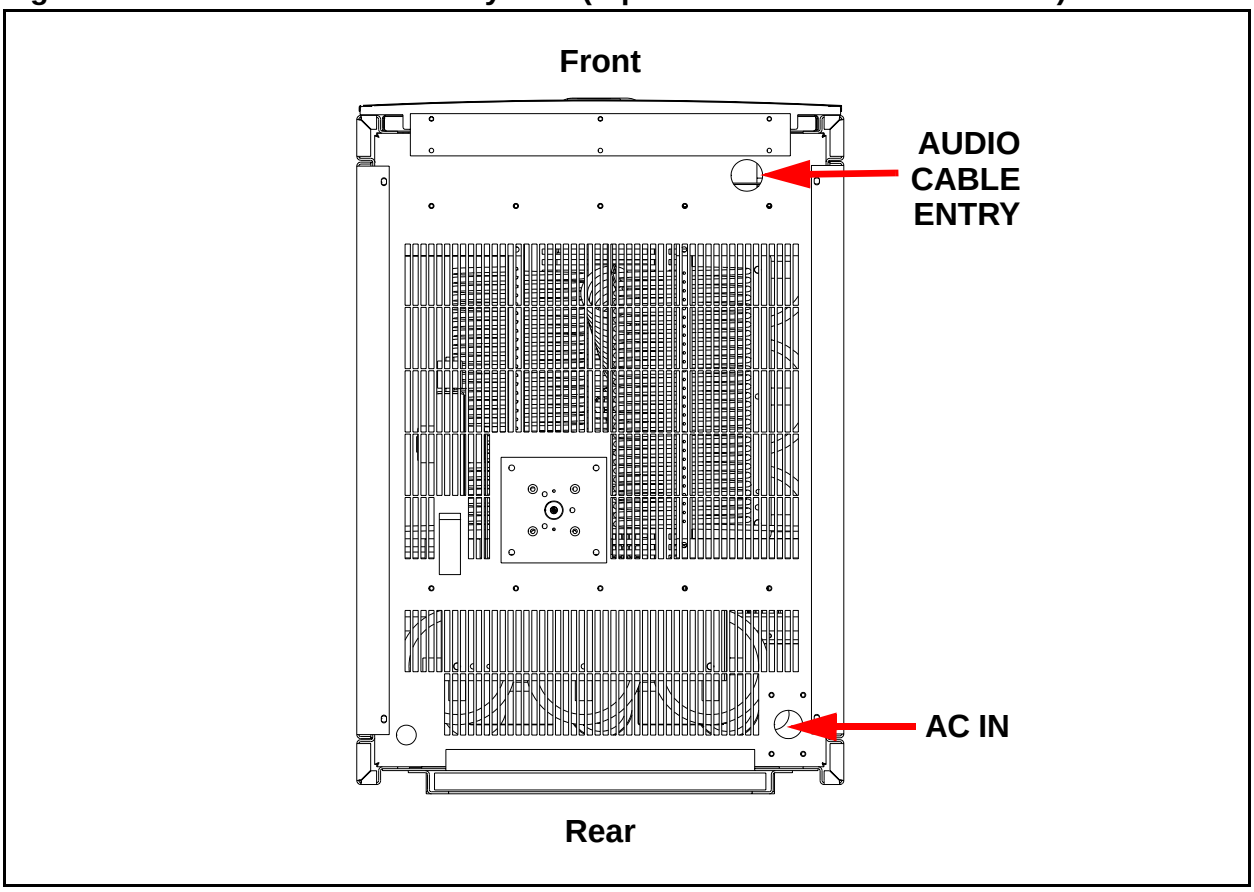
2. Route the cables through the ferrite toroid provided in ancillary kit. Route the Mag cable toward the remote interface PWB at the top of the transmitter, behind the GUI panel, and route the Phase cable toward the RF drive buffer PWB at the bottom of the transmitter.

Connections for an IBOC installation

1. Connect the NE-IBOC Phase output to J14 on the RF drive buffer PWB (at the bottom of the transmitter) using Cat 5 cable. See Figure 8.1 on page 8-2 .

2. Connect the NE-IBOC Mag output to J10 on the remote interface PWB (behind the GUI at the top of the transmitter) using Cat 5 cable. See Figure 6.3 on page 6-4.

Figure 8.3: Location of cable entry hole (top view of XR6/XR3 transmitter)



Section 9: Control and monitoring

This section describes control and monitoring of the XR6/XR3 transmitter. This section includes the following topics:

Controls

The XR6/XR3's graphic user interface (GUI) lets you control a number of transmitter functions and set parameters and schedules. (For detailed information about the GUI, refer to the *XR6/XR3 Operating and Maintenance Manual*.) In addition, you can control the on/off status, the active (A/B) exciter, the preset RF power level, the power level adjustment, and system alarm reset remotely by means of a conventional remote control interface (see "Remote control circuits and alarms" on page 9-7 or a LAN, using the optional NxLink module (see "LAN interface (NxLink)" on page 9-13).

Alarm definitions

This section describes the alarms that may occur, and what they indicate.

DC voltage supply faults

Fan P/S fault

The 48 V power supply used for the fans is monitored. A fault will be reported if the voltage varies by more than ± 10%.

RF drive P/S fault

The 62 V power supply used for the RF drive is monitored. A fault will be reported if the voltage varies by more than ± 10%.

LVPS fault

The +24 V, +15 V, -15 V and +5 V power supplies are monitored. A fault will be reported if the voltage varies by more than ± 10%.

- One or more of these faults will result in only one **LVPS Fault** message on the **Status** screen, though each one would be logged separately in the **Event Log**.

High B+ voltage

A fault is reported when the B+ voltage goes above 380 V. No other action will be performed automatically.

Low B+ voltage

For three-phase XR6 transmitters, there are three B+ voltage levels that will be automatically selected to provide optimum performance: 315 V, 190 V and 115 V. For three-phase XR3 transmitters, there are two B+ voltage levels: 220 V and 115 V. For single-phase XR6 transmitters, there are four B+ voltage levels: 315 V, 196 V, 115 V and 69 V. For single-phase XR3 transmitters, there are four B+voltage levels: 220 V, 196 V, 115 V and 69 V.

This alarm is triggered when the B+ voltage falls below the factory-set alarm threshold. The alarm threshold is factory calibrated to be approximately 250 V, 150 V or 91 V - for three-phase XR6 transmitters - to correspond to the B+ voltage level currently in use. For three-phase XR3 transmitters, the alarm threshold voltage is factory calibrated to be approximately 174 V or 91 V. For single-phase XR6 transmitters, the alarm threshold voltage is factory calibrated to be approximately 250 V, 155 V, 91 V or 55 V. For single-phase XR3 transmitters, the alarm threshold voltage is factory calibrated to be approximately 175 V, 155 V, 91 V or 55 V.

Besides being noted on the transmitter's GUI **Status** screen, and by the alarms, this alarm also causes the following:

- a shutback
- the softstart relays to open
- the fans to turn off

Recovery from this alarm is automatic when the B+ voltage rises above the factory-set alarm threshold, which is factory-calibrated to 265 V, 160 V and 97 V - for three-phase XR6 transmitters - depending on which B+ voltage is selected (see "Low B+ voltage" on page 9-2). For three-phase XR3 transmitters, the factory-calibrated threshold is 185 V or 97 V. For single-phase XR6 transmitters, the factory calibrated threshold is 265 V, 165 V, 97 V or 59 V. For single-phase XR3 transmitters, the factory calibrated threshold is 185 V, 165 V, 97 V or 59 V. The recovery process is the same as the power on process.

Output network faults

High DC current

This alarm is triggered when the dc current goes above approximately 41 A (XR6) or 21 A (XR3).

High RF current

This alarm is triggered when the RF current exceeds the factory-set alarm threshold.

High VSWR shutback

This alarm is triggered when the reflected power exceeds the factory-set alarm threshold - approximately 480 W (XR3) or 960 W (XR6).

Total power limit

This fault is triggered when the product of the B+ (dc) voltage and the dc current is greater than approximately 15 kVA (XR6) or 7.5 kVA (XR3).

- This fault causes an immediate *cutback*, but not a *shutback*.

Exciter faults

Mod driver fault A

This fault is reported to the microcontroller only if exciter A is selected. If the exciter transfer function is set to *auto*, then the microcontroller will attempt a changeover to exciter B. If it cannot, or if the exciter transfer function is set to *manual*, then this fault will cause a *shutback*.

Mod driver fault B

This fault is reported to the microcontroller only if exciter B is selected. If the exciter transfer function is set to *auto*, then the microcontroller will attempt a changeover to exciter A. If it cannot, or if the exciter transfer function is set to *manual*, then this fault will cause a *shutback*.

Auto changeover

This event is caused by a fault in the active exciter when the exciter transfer function is enabled (set to *auto*). These faults cause exciter changeovers: Mod Driver Fail A/B, RF Driver Fail, or PDM Drive Fail.

This fault causes the Changeover LED on the transmitter's front panel to light. It will remain lit until it is manually cleared. No further auto changeovers are possible until the alarm is cleared.

- The Auto changeover alarm can be cleared remotely by re-selecting the active exciter, or locally by using the transmitter's GUI Preset screen.

RF driver fault

This fault indicates a problem with the RF drive on the current exciter. If the exciter transfer function is set to *auto*, then the microcontroller will attempt a changeover to the other exciter. If it cannot, or if the exciter transfer function is set to *manual*, then this fault will cause a *shutback*.

PDM drive fault

This fault indicates that the PDM drive has stopped functioning. If the exciter transfer function is set to *auto*, then the microcontroller will attempt a changeover to the other exciter. If it cannot, or if the exciter transfer function is set to *manual*, then this fault will cause a *shutback*.

Cutbacks

Cutback level (1-8)

If three shutbacks occur within five seconds, the transmitter will enter a power reduction mode called a *cutback*.

There are eight levels of cutbacks, the last being a reduction to almost no forward power.

At any given cutback level, there is a predefined time limit that must expire before the cutback level returns to the previous level (e.g., level three back to level two). If there are no further cutbacks, this process continues until *Level 0* (normal) is reached.

The cutback recovery process can be overridden by adjusting the power (up or down), or by initiating a reset - by pressing **Reset** on the transmitter's GUI **Status** screen or by remote application.

Remote interface faults

Ext. interlock open

The external interlock input is wired to the remote interface PWB by the end user, and triggered by the conditions that they set (e.g., opening the door to the transmitter room). A triggered interlock may indicate a safety issue.

Ext. PDM inhibit

An **EXTERNAL PDM INHIBIT** alarm indicates that an external PDM inhibit command is present. The external PDM Inhibit is wired to the remote interface PWB.

Int. serial fault

This alarm indicates that there is no communication with the remote interface PWB.

The control/display PWB requests updates from the remote interface PWB every 200 ms. This alarm is triggered when a control/monitor PWB's request for information is not acknowledged by the remote interface PWB within two seconds.

Mod. protection

This fault is reported from the remote interface PWB. The fault indicates that excessive low frequency modulation has triggered the transmitter's protection circuit.

Softstart faults

Softstart active

The softstart relays are initially open for 1.6 seconds when the transmitter is first powered on. The software should close the relays after 1.6 seconds and clear this alarm.

While active, this alarm causes a *shutback* and inhibits the RF drive and fan power supplies.

Softstart overtemp

The software keeps track of the calculated temperature of the softstart resistors and triggers this fault if that value is greater than 150°C (302°F).While this fault is on, RF power will not be available.

The temperature is assumed to rise 20°C (68°F) for each cold start, and 10°C (50°F) for each warm start. The calculated temperature falls exponentially between starts.

The transmitter's GUI **Status** screen will show the current, calculated temperature, if it is above 150°C (302°F).

CAUTION:
Performing a warm or cold start while this fault is active is strongly discouraged.

RF Power module faults

PM Fault A or B*

- A fault is being reported by power module A or B.

* **Note:** A second RF power module is optional with an XR6 or XR3 transmitter.

Other faults

Low backup battery

This fault indicates that the backup battery voltage has fallen below an acceptable level. The fault may be caused by weak batteries, or a fault in the detection or alarm circuitry on the control/monitor PWB.

The backup battery should be replaced while ac power is **ON**. *If the ac power faults, without adequate backup battery power, then the log files will be lost.*

CAUTION:
Do not wait for an extended period to replace the batteries. The control/monitor PWB's microcontroller may not retain its settings if ac power is turned off when the backup battery voltage is too low.

Remote control circuits and alarms

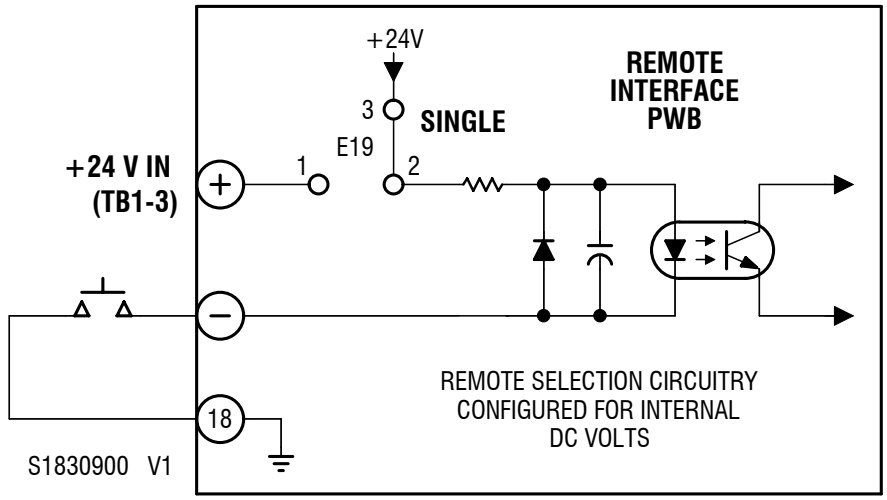
You can control the active (A/B) exciter, the on/off status of the RF power stage, the preset RF power level, the power level adjustment, and system alarm reset remotely. The remote interface PWB contains a selection circuit that lets you select internal (single ended input) or external (differential input) input for all controlled functions.

The external control circuits interface with the transmitter through opto couplers on the remote interface PWB. The opto couplers buffer and isolate the external circuits and prevent any unwanted transients from affecting transmitter operation while remote control is selected at the transmitter.

The switching circuits for the remotely controlled functions must be the equivalent of a normally open (momentary) switch. The switches must be configured to operate as a single-ended input using the transmitter's 24 V dc as the source, or as a differential input using an external dc power supply (24 - 30 V). Each control function has negative inputs on the remote interface PWB. The positive external **+24 V IN** input (TB1-3) is used by all control functions.

Option 1 - Single Ended Input (Internal V dc). When you use the transmitter's 24 V as the current source for a control function's opto coupler, configure the circuit on the remote interface PWB for a single ended input. The **SINGLE/DIFF** 3-pin header (E19) must have its 2-socket shunt post connected between pins 2 and 3 to configure the circuit.

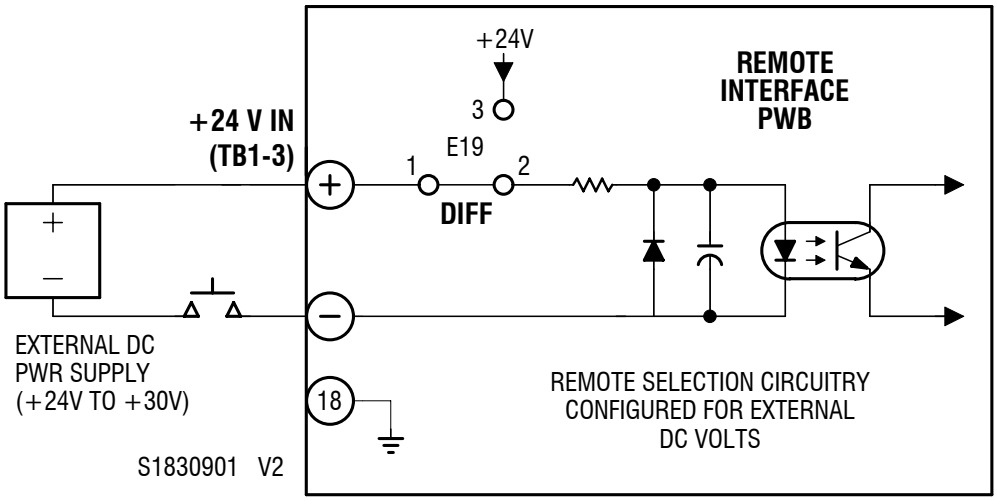
Figure 9.1: Single-ended Input Selected



A negative logic (active state is a current-sink-to-ground) command must be applied to the control's negative (-) input. To avoid a ground loop, obtain the ground from TB1-18.

Option 2 - Differential Input (External V dc). When you use an external dc voltage (24 V to 30 V) as the current source for a control function's opto coupler, configure the control function's external switching circuit and the remote interface PWB's selection circuit for a differential input. The SINGLE/DIFF 3-pin header (E19) must have its 2-socket shunt post connected between pins 1 and 2 to configure the circuit.

Figure 9.2: Differential Input Selected



The normally open/momentarily closed switch should be located between the dc voltage's negative output and the remote control circuit's negative (-) input.

Inputs

This section describes the remote inputs to the system. These inputs are only accepted by the system if the remote/local status is set to remote, unless otherwise noted. That setting can only be made by a local user.

Inputs are toggled between states by an active pulse unless otherwise noted. To ensure proper operation, the duration of the active pulse should be a minimum of 250 ms.

Note: The external PDM inhibit input is intended to be used in conjunction with antenna switching circuitry, to ensure minimal RF output current is flowing during the opening/closing of contacts in the transmitter's RF feed cable. An active **PDM inhibit** condition must be applied, to inhibit the RF output, prior to contact opening. The active condition must be maintained until contact closure has occurred, and an appropriate impedance has been connected to the transmitter's RF output. The RF output will instantly be restored to its original level when the active condition is removed.

- TB2-6 (-): PDM INHB terminal. Continuous active signal inhibits the PDM by causing a shutback. This also works when the remote/local status is set to local.

- TB1-1 and TB1-2: EXT INTLK terminals. A short circuit between the pins for normal operating status, an open between these pins causes a shutback. This also works when the remote/local status is set to local.

- TB1-4 (-): RF OFF terminal. Same as pressing the RF Off button on the front panel. Provide an active pulse to activate.

- TB1-6 (-): RF ON terminal. Same as pressing the RF On button on the front panel. Tells the system to provide RF power if possible. Provide an active pulse to activate.

- TB1-8 (-): RESET terminal. Causes a system reset. Provide an active pulse to activate.

- J3-23 (-): *IBOC Input Select A* input. Sets IBOC/Analog for Exciter A. Continuous active signal selects IBOC input, otherwise analog input is selected.

- J3-25 (-): *IBOC Input Select B* input. Sets IBOC/Analog for Exciter B. Continuous active signal selects IBOC input, otherwise analog input is selected.

- J2-10 (-): *Preset Scheduler (Auto/Man)* input. Enables or disables the Automatic Preset (formerly power level) changes. Provide an active pulse to toggle between Auto or Manual modes.

The following inputs will only take effect when the Preset Scheduler Mode is set to Manual.

- J2-12 (-): *Preset 1* input. Selects RF power preset 1 of 6. Provide an active pulse to activate.

- J2-14 (-): *Preset 2* input. Selects RF power preset 2 of 6. Provide an active pulse to activate.

- J2-16 (-): *Preset 3* input. Selects RF power preset 3 of 6. Provide an active pulse to activate.

- J2-18 (-): *Preset 4* input. Selects RF power preset 4 of 6. Provide an active pulse to activate.

- J2-20 (-): *Preset 5* input. Selects RF power preset 5 of 6. Provide an active pulse to activate.

- J2-22 (-): *Preset 6* input. Selects RF power preset 5 of 6. Provide an active pulse to activate.

Note: A minimum one second interval between commands is required for the following two exciter selection commands.

- TB1-14 (-): EXCITER A terminal. Causes a changeover to select exciter A as the main exciter. Setting is saved in current preset. Provide an active pulse to select this exciter.

- TB1-16 (-): EXCITER B terminal. Causes a changeover to select exciter B as the main exciter. Setting is saved in current preset. Provide an active pulse to select this exciter.

- TB1-10 (-): POWER INCREASE terminal. Increases the power level of the current preset. Send an active pulse to increase the power slightly, or send a signal of greater duration to continue increasing the power.

- TB1-12 (-): POWER DECREASE terminal. Decreases the power level of the current preset. Send an active pulse to decrease the power slightly, or send a signal of greater duration to continue decreasing the power.

Remote status and alarm indications

Outputs that indicate the status of operator controlled circuits are available on connectors J2 and J3 on the remote interface PWB. A switching device for each alarm output provides current-sink-to-ground when a logic true condition exists.

The switching circuit provides an open collector for a logic false condition and has no influence on the external monitoring circuit.

The following outputs are available:

Note: All outputs are active low.

- J3-18: *Exciter Changeover*. See "Auto changeover" on page 9-3.

- J2-24: *Preset Scheduler On Status*.

- J3-21: *Auto Exciter Status*. Indicates if the current preset allows auto exciter changeover in the event of failures. (Set from the GUI only.)

- J3-20: *Memory Battery Alarm*. See "Low backup battery" on page 9-5.

- J3-19: *RF Overcurrent Alarm*. See "High RF current" on page 9-3.

- J2-23: *Exciter B Status*. Indicates which exciter is presently active.

- J3-15: *LVPS Fail*. See "LVPS fault" on page 9-2.

- J3-14: *Exciter Fail*.

- J3-13: *Pwr Mod Fail*. One or more power modules has a fault.
- J3-12: *Low B+*. See "Low B+ voltage" on page 9-2.
- J3-11: *High VSWR*. See "High VSWR shutback" on page 9-3.
- J3-17: *Cutback*. See "Cutback level (1-8)" on page 9-4.
- J3-16: *Shutback*. Indicates that a shutback is currently active.
- J3-3: *RF On Status*. Indicates that the RF On LED is active, showing the operator's request for RF power.
- J3-(5,6,7,8,9,10): *Preset (1-6) Status*. Indicates which preset is currently active.
- J3-4: *Remote Status*. Indicates whether or not the system is in Remote or Local control mode. Changes can only be made remotely if the transmitter is set to Remote mode. The local user's control of transmitter operation is limited, unless the transmitter is set to Local mode.

Remote performance monitoring

The transmitter provides outputs that let you monitor RF performance. They include dc voltages that represent the forward power level, the reflected power level, the B+ voltage and the dc current. In addition, a true RF sample of the RF output voltage waveform is available for external monitoring. These outputs are provided on the remote interface PWB.

Analog samples

Sample voltages, in the range of 0 to 4 V are provided for the following system parameters:

- J2-1: *Fwd Power*
- J2-3: *Refld Power*
- J2-5: *B+ Voltage*
- J2-7: *Dc Current*
- J8: *RF Monitor*

Forward power level. A buffered dc voltage that reports the forward power level on J2-1. This voltage is a pure square law function and will be 3.9 ± 0.5 V when the forward power is 6.5 kW (XR6) or 2.8 ± 0.5 V when the forward power is 3.3 kW (XR3). The monitoring circuit's impedance must be greater than 1,000 ohms.

Reflected power level. A buffered dc voltage that reports the reflected power level on J2-3. This voltage is a pure square law function and will be 3.9 ± 0.5 V when the reflected power is 960 W (XR6) or 2.8 ± 0.5 V when the reflected power is 480 W (XR3). The monitoring circuit's impedance must be greater than 1,000 ohms.

B+ volts. A buffered dc voltage on J2-5 that is directly proportional to the dc voltage from the main dc power supply. This voltage will be 3.0 V when the dc voltage being applied to the RF stage is 312 V. The monitoring circuit impedance must be greater than 1,000 ohms.

Dc Current. A buffered dc voltage on J2-7 that reports the dc current level of the main B+ power supply. The output is 3.0 ± 0.5 V with a dc current of 40 A.

RF monitor sample. A true sample of the RF output voltage waveform is available through the J8 BNC connector (RF MONITOR) on the remote interface PWB. The RF monitor output is intended to be applied to a station modulation monitor with a 50 Ω input impedance. It may also be monitored by an oscilloscope during maintenance procedures. The RF monitor output can be set to provide 1.0 V rms or 5.0 V rms for each preset power level, provided they are preset to a level that is between 600 W and 6 kW (XR6) or between 300 W and 3 kW (XR3).

Note: Some older modulation monitors may not accept a 1 V input.

Note: The output level range is determined by the setting of the BYPASS/GAIN switch. When the switch is set BYPASS, the RF monitor sample voltage is a nominal 1 V rms. When the switch is set to GAIN, the RF monitor sample voltage increases to a nominal 5 V rms. The rms output level is adjusted from the GUI. Setting the level higher than the limit determined by the BYPASS/GAIN switch [1 V rms or 5 V rms (carrier)] will cause distortion in the waveform, and may prevent accurate measurement of the modulation depth.

LAN interface (NxLink)

A serial port is available on 9-pin D-sub connector J12 of the XR6/XR3's remote interface PWB. This port allows you to remotely control and interrogate the XR6/XR3's operational status. If the NxLink Ethernet interface module option is installed and you wish to use it as the remote interface, connector J12 is linked to Port 1 of the NxLink module. Refer to the *NxLink Technical Instructions Manual* for further details on the NxLink module.

Section 10: Other considerations

This section describes other considerations regarding the XR6/XR3 transmitter.

External RF drive source

You can apply an externally generated RF drive (carrier frequency only) to the remote interface board's digital EXT RF IN BNC connector (J6). This replaces the internal carrier frequency oscillator for one or both exciters (A/B).

Note: There is only one external RF drive input. If you use it for both exciters, duplicate the RF drive source (main/standby), and incorporate an automatic changeover circuit to select the standby source if the main source fails.

The external RF drive must:

- be the carrier frequency (fc), within ± 5 Hz or 5 parts per million (ppm), whichever is greater, when it is not being modulated.
- have a peak-to-peak amplitude of between 5.0 V and 12 V (sine wave or square wave).
- be spectrally pure when it is not being modulated.

Note: Any signal connected to the EXT RF IN input may affect the transmitter's RF output. To comply with regulatory limits on emissions, ensure that the RF drive source is acceptable.

Installing an external RF drive source

1. If the RF drive for one or both exciters is to be applied from an external source, connect its wiring as follows:

   – Route RF drive coaxial cable through a cable entry hole in the cabinet and through the ferrite toroid, to the vicinity of the remote interface PWB.
   – Cut the RF drive coaxial cable to length, terminate it with a coaxial BNC connector and connect it to the remote interface PWB's EXT RF connector (J6).

2. Configure either (or both) exciter RF synthesizer(s) to operate on Ext RF drive by setting the E4 jumper(s) to 1-2.

External 10 MHz frequency reference

You can apply an externally generated 10 MHz signal (such as a GPS clock signal) for use as the reference frequency for the RF drive (carrier frequency) to the 10 MHz REFERENCE INPUT BNC connector J2 on each RF synthesizer PWB.

1. The external 10 MHz frequency reference (one for each RF synthesizer PWB) must:

   – remain stable at 10 MHz within ± 20 Hz
   – have a peak-to-peak amplitude of between 2.2 V and 8.0 V (sine wave or square wave)
   – be spectrally pure, since spurs may pass through to the transmitter output.

2. Configure each RF synthesizer PWB by setting E2 to 1-2 and E1 to 1-2.

Section 11: Commissioning tasks

WARNING: Before applying ac power and turning on the transmitter, you must customize some circuits to the station's power source and operating requirements. Do not perform this pre-commissioning unless you are a station engineer or a competent electronics technician.

The transmitter contains solid-state devices that may be damaged if subjected to excessive heat or high-voltage transients. Ensure that circuits are not overdriven or disconnected from their loads while turned on.

The transmitter was precisely calibrated and tested during manufacturing. Do not change any adjustments other than those specified

Note: This procedure refers to the RF synthesizer and PDM interphase driver PWBs. These printed wiring boards are located on the exciter panel.

Pre-commissioning tasks

Ac power source

1. Confirm the ac power source's nominal, loaded, phase-to-phase, rms voltage.

2. Ensure that ac power source is switched off at the service entrance.

WARNING: If you do not observe this precaution, you could be seriously injured or killed by the voltages on the circuit breaker and the transformer terminals.

3. Identify which primary winding taps should be used and connected to the transformer's ac power input (Line) terminals. See Table 2.1 on page 2-3.

4. Confirm that the taps are configured correctly.

Exciter RF drive board

5. The default is INTERNAL RF DRIVE. See Section 8, "Audio and IBOC inputs" on page 8-1 and Section 10, "Other considerations" on page 10-1 for information on using an external RF drive source.

Internal/external RF drive source

6. RF synthesizer PWBs can use their integral RF oscillator, or an external RF generator, as their RF drive source. Verify that the transmitter is configured to use the desired RF drive source.

Audio Lowpass Filter

7. The remote interface PWB A2A6 on the exciter panel allows you to select one of four audio bandpass filters by setting the AUDIO FILTER switch (S1). Determine the most suitable roll-off frequency and then set the AUDIO FILTER switch accordingly. The factory default selection provides a -1.0 dB roll-off at 16 kHz. This selection is suitable for most installations.

> Note: A three-pole Butterworth filter that can be altered to provide a pseudo-Bessel response is used as the low-pass audio filter. Reasons for using a lower roll-off frequency are complex, but may include an antenna with sideband limitations, square-wave overshoot, or specific properties related to the audio processing. Nautel's field service department can provide recommendations based on your installation.

8. Refer to Table 11.1 to determine the available roll-off frequencies and settings. Record the selected roll-off frequency and the AUDIO FILTER switch settings for future reference.

Table 11.1: Audio Pass Band Selection (high frequency audio filter) switch settings

(-1.0 dB)	S1-1	S1-2
16.0 kHz	CLOSED	CLOSED
13.5 kHz	OPEN	CLOSED
10.5 kHz	CLOSED	OPEN
7.5 kHz	OPEN	OPEN

Commissioning

Turning on the transmitter

1. Terminate the transmitter's RF output into a precision, 50 Ω resistive dummy load that is able to dissipate the RF power being applied to it: 6 kW carrier, 9 kW total required (XR6) or 3 kW carrier, 4.5 kW total required (XR3).

2. Verify that all panels are installed, and ensure that their attaching hardware is firmly tightened.

WARNING:
If a jumper is placed between interlock inputs TB1-1/TB1-2 on the remote interface PWB, safety features controlled by the external interlocks will be disabled. A fail safe method of alerting personnel to this fact should be implemented. Voltages which are dangerous to life will be present on the RF output stages and the antenna system if the transmitter is turned on.

3. Simulate the closing of all external interlocks. This requires a short circuit between TB1-1 and TB1-2 of the remote interface PWB. Ensure all networks connected to the transmitter's RF output are properly covered.

4. In lieu of normal station programming, connect an audio signal generator, preset to 1000 Hz at a zero output level (turned off), between TB2-1 (+) and TB2-3 (-) on the remote interface PWB.

5. Switch on the ac power at the service entrance to turn on the transmitter.

6. Look through the window on the left side of the transmitter's lower rear panel (as seen from the back). Verify that both power status LEDs are on.

7. Check the alarm and status indicators (the front panel and GUI). See the *XR6/XR3 Operating and Maintenance Guide.*

8. Check the output of the B+ power supply on the GUI. The voltage should be between 320 and 340 V dc.

9. Check the output of the 5, 15, and 24 V power supplies on the GUI.

10. Select **Local** control.

11. Set the active preset's power output to zero by pressing Increase and Decrease simultaneously.

12. Press RF ON.

13. Check the output of the 48 V and 62 V power supplies.

14. Ensure that the fans are running – listen for the sound of the fans.

15. Check for alarms on the status screen.

16. With an oscilloscope, verify the RF drive frequency and duty cycle on the RF drive buffer PWB (NAPE77) test output J5, located on the bottom, front of the transmitter.

17. Monitor the B+ voltage level using the GUI's meters screen. Initially the B+ switching level - displayed on the top line of the GUI - should be B+0, which should correspond to a B+ voltage between 59 and 79 V.

> Note: The transmitter's RF output power will be momentarily inhibited when the B+ level switches.

18. Slowly increase the power and observe the transition of the B+ switching level (through B+1, B+2 and B+3, as applicable for your power level). The B+1 level should correspond to a B+ voltage between 105 V and 125 V; the B+2 level should correspond to a B+ voltage between 186 V and 206 V; the B+3 level should correspond to a B+ voltage between 305 V and 325 V for XR6 or between 210 V and 230 V for XR3.

19. Increase the power to normal operating levels and ensure that PA Volts remains within specification [that is, Sqrt(Pout/ kW)*130 V = PA Volts within 15%].

20. Check the reflected power level. It should be near 0 W.

21. Set up preset power levels. See the *XR6/XR3 Operating and Maintenance Guide.*

22. Set up the RF monitor output. Depending on the setting of the remote interface PWB's BYPASS/GAIN switch, the RF monitor should be set no higher than 1 V rms (2.8 V pp; switch set to BYPASS) or 5 V rms (14 V pp; switch set to GAIN) at each power level, when operating into a 50 Ω load.

Modulation checks

Verify that the RF output is appropriately modulated when audio is applied:

23. Connect an appropriate modulation monitor to the remote interface PWB's RF MONITOR connector (J8). The modulation monitor should have an impedance of 50 Ω to obtain accurate readings.

24. Verify that forward power is selected for display on the RF KILOWATTS meter.

25. Select the highest preset RF power level and verify that the RF output, displayed on the RF KILOWATTS meter, is the desired forward power level.

26. Verify that an audio signal generator is connected between TB2-1 (+) and TB2-3 (-) on the remote interface PWB, and that its output is preset to 1,000 Hz at a zero output level (turned off).

27. Turn off the audio signal generator and increase the output level of the audio signal generator until a modulation depth of 100% is attained, as indicated on the modulation monitor. The audio signal generator's output level should be +10 dBm.

28. Verify that the RF output's modulation envelope is acceptable.

29. If the program audio can be set to +10 dBm when 100% modulation is required, it is recommended the AUDIO GAIN potentiometer on the interphase PDM driver PWBs be left at the factory setting.

30. If the program audio cannot be set to +10 dBm when 100% modulation is required, the AUDIO GAIN potentiometer on the remote interface PWB must be reset as follows:

    – Determine the program audio level (in dBm) that will be applied when 100% modulation is expected. (It must be between 0 dBm and +12 dBm.)
    – Set the audio signal generator's output to the level that will be applied by the program audio when 100% modulation is expected.
    – Adjust the AUDIO GAIN potentiometer on the remote interface PWB for 100% modulation, as indicated on the modulation monitor.

31. Set the output level of the audio signal generator to zero (turned off).

32. Turn off the RF power stage: press and release the RF OFF switch. The RF OFF lamp will turn on and the RF ON lamp will turn off.

33. Disconnect the audio signal generator from TB2-1(+) and TB2-3(-) on the remote interface PWB.

Going on-air

WARNING:
If a jumper is placed between interlock inputs TB1-1/TB1-2 on the remote interface PWB, safety features controlled by the external interlocks will be disabled. A fail safe method of alerting personnel to this fact should be implemented. Voltages which are dangerous to life will be present on the RF output stages and the antenna system if the transmitter is turned on.

Important: Before going on the air, if you want the safety interlocks to operate properly, the shorting jumpers installed in "Turning on the transmitter" on page 11-3, Step 3 should be removed.

When the commissioning tests are successfully completed, connect the studio audio to the transmitter's audio input terminals, connect the RF output to its antenna system, and complete any emission tests that are required.

1. Turn off the power using the ac disconnect switch, if one is being used, or else at the ac source.

2. Connect the transmitter's RF output to an antenna system (or verify that the current connection is intact).

3. Turn the transmitter's ac power back on.

4. Use the transmitter controls and graphic user interface to begin transmitter operations. For detailed instructions, refer to the *XR6/XR3 Operating and Maintenance Guide*.

Section 12: Parts and tools

This section describes parts associated with the XR6/XR3 transmitter, and tools needed during installation and routine operation. Topics include:

Contacting Nautel

You can reach Nautel to order parts or for technical assistance at:

Nautel Limited
10089 Peggy's Cove Road
Hackett's Cove, NS Canada B3Z 3J4
Phone: +1.902.823.3900
877 6NAUTEL
Fax: +1.902.823.3183

Email: support@nautel.com

Web: www.nautel.com

Parts supplied by Nautel

Ancillary parts kit

An ancillary parts kit is shipped with the XR6/XR3. This kit contains hardware needed during the installation process. The kit includes toroids, spare fuses, screws and other miscellaneous hardware.

Documentation

See "XR6/XR3 transmitter manuals" on page vii.

Parts not supplied by Nautel

Some parts and materials required to complete installation are not supplied by Nautel. The parts you need vary with the installation requirements. The list of parts you normally provide yourself during installation include:

- A suitable 50 Ω RF output coaxial cable, terminated by the proper connector, complete with center male connector at the transmitter end.
- All external control and monitor wiring, including the associated terminating devices, conduit and conduit clamps.
- All electrical power cables, including conduit, terminating devices, and conduit clamps.

Parts ordering

You can order replacement parts from your Nautel sales agent, or directly from Nautel through the Nautel website.

Module replacement program

Nautel offers a module replacement program for customers who require expedited servicing and replacement of faulty modules. The module replacement program provides immediate replacement of failed modules with refurbished modules.

- The replacement module is shipped to the customer as soon as the customer reports the failure. The customer then returns the failed module to Nautel within 30 days using the same shipping package.

Tools for installation

The tools you need during transmitter installation include the following:

- Digital voltmeter
- Philips screwdrivers, sizes #1 and #2
- Pliers
- Wire cutters
- Slot screwdriver, 5 mm (3/16 inch)
- Metric and Imperial socket set up to 24 mm (15/16 inch)
- Metric and Imperial wrench set up to 25 mm (1 inch)
- Feeler gauge (to measure spark gap)

Section 13: Pre-installation / Installation assistance

Nautel provides a number of support options to help you during pre-installation planning and preparation:

Pre-installation consulting

Nautel field support specialists are available to answer questions and work with you to ensure that your site will be ready for the installation of your XR6/XR3 transmitter. For support, contact Nautel Customer Service and request assistance ("On-site support" on page 13-3).

Installation and commissioning service

Nautel offers an installation and commissioning service to customers who want assistance with configuring and commissioning a new Nautel transmitter. After the customer completes the transmitter assembly and installation, Nautel technical personnel will spend up to three days on-site to help make the ac power, RF and remote connections, and to assist with the configuration and testing of Nautel equipment.

The customer is responsible for ensuring that the following stages of installation have been completed, prior to the arrival of Nautel personnel:

- Ac power wiring for the transmitter has been installed and connected at the breaker panel or the building's service entrance. If local electrical codes allow Nautel personnel to connect the transmitter to the ac supply, using the customer's cable, that task is included in this service. Otherwise, the customer must ensure that an approved electrician is present for this task.

- The customer has prepared the RF coaxial cable – used to connect the transmitter to the antenna – and installed the required connector. The customer has also installed the RF coaxial cable in place and connected it to the antenna, while leaving the transmitter end of the cable unconnected.

- Where required, all remote control and monitoring cables have been installed and connected to the station equipment (e.g., modulation monitor, frequency monitor, and power meter).

- The site has been made ready for the equipment, and adequate protection against lightning and lightning-induced transients has been provided.

- The transmitter has been unpacked, closely checked for any damage caused by shipping, and then assembled.

- The following test equipment has been made available at the site:

  – Two-channel oscilloscope (with probes)

  – Audio signal generator

  – Distortion analyzer

  – Spectrum analyzer

  – Modulation monitor

  – Frequency counter

  – 50 Ω test load (rated for 150% of carrier power, VSWR less than 1.1:1)

Nautel's service representative takes full responsibility for commissioning the transmitter, validating all external interfaces (i.e., the ac supply, RF output, remote control and monitoring equipment) and checking out the equipment prior to activation. The service representative turns on the transmitter, performs all adjustments and set-up procedures, and carries out *proof of performance* tests at the site.

These tests ensure that the transmitter is operating normally in compliance with its specifications. The service representative also provides a demonstration and a short explanation of the operation of the transmitter. Finally, the customer signs an *Acceptance of Installation Certificate* that provides feedback to Nautel regarding the commissioning service.

Online documentation

Nautel provides documentation online to customers, letting you familiarize yourself with specifications, operation, maintenance and troubleshooting prior to the delivery of your equipment. (Documentation is also provided on CDROM and in paper binders that are delivered with the transmitter.)

On-site support

If you require on-site assistance, Nautel's field support specialists can help you prepare your site and ensure that your XR6/XR3 transmitter installation can proceed as quickly as possible. For more information about on-site support, including scheduling and pricing, contact Nautel Customer Service:

- Telephone: +1.902.823.3900
- Fax: +1.902.823.3183
- Email: support@nautel.com

After business hours (Atlantic time or Eastern time in North America), requests sent by fax or email will be acknowledged within one working day.

Training

Nautel's SBE-certified broadcast training programs satisfy your day-to-day knowledge requirements. Students participating in Nautel's broadcast transmitter or RF basics training programs earn one SBE credit for each completed day of training.

Nautel's comprehensive selection of training programs will help customer staff develop valuable skill sets, reduce downtime, and make the most of the customer's technology investment.

Nautel training programs are made up of individual modules that can be 'mixed and matched' to meet the customer's specific training needs. All Nautel training courses are available at the Nautel Training Center. Training can also be provided at the customer's facility, and training the customer's technical staff on the customer's transmitter.

All training courses at the Nautel Training Centre combine classroom and hands-on laboratory work to ensure a balanced learning experience.

Nautel training courses feature:

- Limited class sizes to ensure maximum student participation and access to equipment
- Emphasis on need-to-know, day-to-day knowledge
- Labs that focus on the tasks most often performed at the transmitter site.

Many of our classes also include diagnostic lab exercises.

Standard warranty

Nautel Limited/Nautel Incorporated, hereinafter referred to as Nautel, guarantees all mechanical and electrical parts of the equipment for a period of 13 months from date of shipment.

1. A "Part Failure" shall be deemed to have occurred when the part has become defective, or does not have the characteristics required for the specified equipment performance:

   (a) When the equipment is operated within the design parameters, and

   (b) When the equipment is installed and adjusted according to Nautel's prescribed procedures as stated in the instruction manual.

2. Nautel shall provide replacements for all "Parts" at no cost to the Customer when they become defective during the warranty period, and upon the return of the defective part.

3. In the event that a "Part" fails during the warranty period and causes damage to a sub-assembly that cannot be readily repaired in the field, the entire sub-assembly so damaged may be returned to Nautel for repair. The repairs will be made without charge to the Customer.

4. Where warranty replacements or repair are provided under items 2 or 3, Nautel will pay that part of the shipping costs incurred in returning the part/assembly to the Customer.

5. Warranty replacement parts and repair, which are provided under items 2 or 3, shall be guaranteed for a period of ninety days from date of shipment or until the end of the original warranty period, whichever occurs later.

6. Nautel will not assume responsibility for any charges incurred by other than Nautel employees.

7. Nautel shall have the privilege of investigating whether failures have been caused by factors beyond its control.

8. Nautel shall in no event be liable for any consequential damages arising from the use of this equipment.

9. When requesting a warranty repair/replacement, please provide complete and accurate information. Observe the instructions regarding "Equipment being returned to Nautel" on page 13-6 and provide the information requested.

10. When ordering spare/replacement parts, please provide complete and accurate information. Refer to the parts list of the Repair manual for ordering information. Provide as much of the information requested for 'Equipment Being Returned to Nautel' on page two of this warranty as is practical. The information identified by an asterisk is the minimum required.

Technical assistance

Nautel's field service department provides telephone technical assistance on a 24 hour, seven days a week basis. Requests by other media (facsimile or e-mail) will be responded to the next working day if received after Nautel's normal working hours. Contact the appropriate field service centre from the following:

Nautel Limited
10089 Peggy's Cove Road
Hackett's Cove, NS Canada B3Z 3J4
Phone: +1.902.823.3900 or
Toll Free: +1.877.6NAUTEL (6628835) (Canada & USA only)
Fax: +1.902.823.3183

Nautel Inc.
201 Target Industrial Circle
Bangor, Maine USA 04401
Phone: +1.207.947.8200
Fax: +1.207.947.3693

Customer Service (24 hour support)
+1.877.628.8353 (Canada & USA only)

+1.902.823.5100 (International)

Email: support@nautel.com
Web: www.nautel.com

Module exchange service

In order to provide Nautel customers with a fast and efficient service in the event of a problem, Nautel operates a factory rebuilt, module exchange service which takes full advantage of the high degree of module redundancy in Nautel equipment. This module exchange service is operated from Nautel's factory in Bangor, Maine and Hackett's Cove, Nova Scotia. These two locations allow us to provide a quick turn around service to keep our customers on the air. During the transmitter's warranty period, up to thirteen months from shipment, repair and exchange of modules is at no charge to the customer. When the warranty has expired, a charge of 80% of the list price for all exchanged modules is made. If the faulty module is returned to Nautel within 30 days, a credit is issued reducing this charge by one half to 40% of the list price. USA customers are required to contact our Bangor, Maine facility. Canadian and overseas customers should contact our Nova Scotia, Canada facility.

Equipment being returned to Nautel

For all equipment being returned to Nautel and all requests for repairs or replacements:

- Obtain an RMA number from Nautel (you must have an RMA number to return equipment)
- Mark the item as 'field return'
- Mark the item with the RMA number assigned by Nautel
- Address the item to the appropriate Nautel facility

Complete and accurate information regarding the equipment being returned will ensure prompt attention and will expedite the dispatch of replacements. Refer to the nameplate on the transmitter and/or the appropriate module/assembly to obtain name, type, part and serial number information. Refer to the parts list of this manual or the appropriate service instruction manual for additional ordering information.

The following information should accompany each request (* denotes minimum required information):

- *Model and serial number of equipment
- *Name of part/assembly

- Serial number of part/assembly
- *Complete reference designation of part/assembly
- *Nautel's part number of part/assembly
- *OEM's part number of part/assembly
- Number of hours in use
- Nature of defect
- *Return shipping address

Extended warranties

Nautel's standard 13-month warranty provides excellent coverage and satisfies most customers' needs. However, if you want extended coverage, Nautel offers one and two-year Extended Warranty Plans to cover electrical and mechanical repairs or replacements for all Nautel equipment.

Coverage

The Extended Warranty Plan includes:

- A module exchange program for many common modules and circuit boards (North America only)
- Toll-free hotline (North America only)
- Necessary labor performed by Nautel authorized personnel to repair the product back to factory specifications
- Necessary components
- Modifications to correct performance problems
- Return shipping.

Details

Extended Warranty Plans must be purchased prior to the expiration of original 13-month warranty.

One-year Extended Warranty Plans add an additional year (12 months) of coverage after the end of the customer's standard 13-month warranty. The two-year plan adds an additional two years (24 months).

Only repairs done at Nautel's facilities or by Nautel authorized personnel will be covered by the Extended Warranty Plans.

You must ship faulty products back to Nautel, prepaid, and in the original package or in a package that provides equivalent protection.

Nautel can choose to repair or replace equipment.

Purchasing a one or two-year Extended Warranty Plan

If the transmitter is still covered by its original 13-month warranty period, you can contact Nautel by telephone, fax, mail, or email with the model number, serial number and date of purchase.

Once you purchase a Nautel Extended Warranty Plan, you receive an extended warranty plan certificate, plan number, and a toll-free number (North America only) to call for any service-related issues.

Using the Extended Warranty Plan

Contact Nautel's Canadian or U.S. service facility by phone, fax, or email as soon as a problem occurs. The following will be required when contacting Nautel:

- Extended warranty plan number
- Product model number
- Serial number
- Brief description of the problem

If Nautel's service technicians are unable to solve the problem over the telephone, Nautel will give you an RMA number. You then return the module or circuit board to a Nautel service facility so that Nautel can provide a replacement. (Do not ship a component back to Nautel until you have an RMA number.)

Section 14: List of terms

This section defines some of the terms that are used in Nautel documentation.

AES-EBU. Audio Engineering Society/European Broadcasting Union (AES/EBU) is the name of a digital audio transfer standard. The AES/EBU digital interface is usually implemented using 3-pin XLR connectors (the same type connector used in professional microphones). One cable carries both left- and right-channel audio data to the receiving device.

AMC. Amplitude Modulation Companding

Antenna Tuning Unit (ATU). A device that matches the transmitter to the impedance of the antenna.

B+. The high voltage dc generated by the transmitter's ac power supply for use within the transmitter. The B+ voltage is used to supply the transmitter's modulators and other transmitter circuitry.

Cutback. A reduction in RF output power, caused by a total power limit fault or the occurrence of three shutbacks within a five second period.

DAM. Dynamic Amplitude Modulation.

DCC. Dynamic Carrier Control.

DSP. Digital Signal Processing.

HD Radio. High Definition (HD) Radio is another term for In Band On Channel (IBOC) technology. HD Radio is a trademark of iBiquity Digital Corporation.

IBOC. Nautel In-Band-On-Channel technology provides high quality digital audio over existing AM radio channels.

IPM. Incidental Phase Modulation

NE IBOC. Nautel's In-Band-On-Channel signal generator. See IBOC. Required for XR series IBOC installations.

PDM. Pulse Duration Modulation.

Preset. A setting that controls power level, active exciter, and power scheduler status on a time-of-day and date basis. Exciters can be configured on a preset for a specific operating mode (for example, Exciter A - conventional AM, and Exciter B - IBOC). The XR6/XR3 allows you to pre-program up to six presets.

Shutback. A complete loss of RF output power, caused by any one of a variety of faults, including high VSWR, low B+ voltage, high RF current, RF drive failure, external interlock or spark gap.

Surge protection board. An electrical panel that protects equipment from electrical surges in the ac power supply, antenna or site ground caused by lightning strikes.

VSWR. Voltage standing wave ratio. This is an expression of the ratio of forward voltage to reverse voltage on the feedline and antenna system. An ideal VSWR of 1:1 provides maximum transmitter-antenna efficiency.

Index

XR6/XR3

Installation Manual

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